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INFORMAL REPORT

Report of the
Subcommittee on Standard Interface Files

los alamos
scientific laboratory

of the University of California

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Report of the Subcommittee on Standard Interface Files

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ABSTRACT

This report was informally distributed originally to the Committee on Computer Code Coordination (CCCC) for Reactor Physics Codes. Because of several requests received, the report is reproduced herein. It contains the specifications for the standard interface data files developed by the CCCC for application to reactor physics codes.

1. INTRODUCTION AND SUMMARY

A principal activity of the Committee on Computer Code Coordination has been the development of a set of "Standard Interface Files." These files contain the major data blocks that must be transferred between computer codes in the performance of Reactor Physics calculations. It was recognized early that, if standard forms for these I/O data files could be agreed upon and implemented in future codes, many of the problems associated with the coordination of code development and the exchange of codes between laboratories would be alleviated.

To test the feasibility of standardizing I/O interface files, the Committee created a set of files for use as interfaces between a selected set of Reactor Physics codes. The types of codes considered were cross-section processing codes, neutron transport and diffusion codes, perturbation codes, and fuel-cycle codes. Representative codes in each of the above areas were chosen for trial adaptation to the interfaces. Test calculations performed with the revised codes at the various laboratories proved the feasibility of standard interfacing, but many recommendations for improvement of the preliminary files were also a by-product of the tests. A three-man Subcommittee was then selected to implement these proposed revisions. The work of this Subcommittee is reported herein.

Revisions made to the original files are extensive. The data are separated into a larger number of files to provide more flexibility and efficiency in the use of the files. A list of the new file names and a general description of the file contents are given in Table I. An identification record is placed at the head of each file to facilitate file retrieval. Allowance is made for the existence of several versions of the same file and for the possibility that, at some installations, several users may store files on a common device.

With one exception, each file is made an independent entity. This means that each file contains a specifications record immediately following the identification record that contains all the dimension parameters and flags essential to the reading of the file. Thus, the reading of any given file is not contingent upon data contained in any other file. The density data file, ZNATDN, is an exception to the above. Information given in the nuclide

TABLE I

STANDARD INTERFACE FILE NAMES AND GENERAL CONTENTS

<u>Name</u>	<u>General Description of Contents</u>
ISOTXS	Nuclide-ordered microscopic broad-group cross-section data.
GRUPEX	Group-ordered microscopic broad-group cross-section data.
ELAYXS	Delayed neutron precursor data.
BRKXS	Microscopic cross-section data in the Bondarenko form.
GEODST	Geometry description.
NDXSRF	Nuclide density and cross-section referencing parameters.
ZNATDN	Zone nuclide atomic densities, including subzone or subassembly scale.
SEARCH	Criticality search data.
SNOONS	S_n constants.
FIXSRC	Distributed and surface fixed sources.
RTFLUX	Regular total (scalar) neutron flux.
ATFLUX	Adjoint total (scalar) neutron flux.
RCURNT	Regular neutron current.
ACURNT	Adjoint neutron current.
RAFLUX	Regular angular flux.
AAFLUX	Adjoint angular flux.
RZFLUX	Regular zone flux by neutron group, averaged over each zone.
PWDINT	Power density by interval.

density and cross-section referencing file, NDXSRF, must be available before ZNATDN can be used.

The data in the files have been reorganized into larger records, subject to core memory constraints, to promote file handling efficiency. An algorithm is given in the description of each record from which the number of words in the record may be computed. This facilitates the use of subroutine calls for transferring records between core and peripheral devices.

Other data reorganizations have been adopted to make the files conform more closely to code usage, and to provide greater capability for handling large problems. A multigroup cross-section file, GRUPEX, organized by neutron group rather than by isotope is provided since cross-section data are normally stored by group in multidimensional problems. Atom density data have been rearranged to expedite the handling of large numbers of isotopes in fuel-cycle work. Regular and adjoint data from flux codes

have been placed in separate files with different data organizations corresponding to the differences between regular and adjoint output from flux codes.

Two files have been added which contain data that were not included in the old files. One of these is the source file, FIXSRC, which contains specifications for distributed or boundary sources in any of the standard geometries. A power density file has also been added which provides for specification of the power profile by interval over regions of interest.

A list of the types of codes considered to date in the development of interfaces is given in Table II, "Computer Code Interfacing." The function of

each type of code is described, and lists of the input and output interface files required by each type of code are shown. It is not intended that Table II be considered as a specification for a code system, but rather it is a specification of the standard files that should be included in each prototype code when it is prepared as a free-standing code for exchange. Obviously, when additional codes are added to the current lists, the list of interface files will require extension. Mass balance data would be required, for example, from the output of the fuel-cycle code for input to an economics code, and kinetics parameters generated by the perturbation code would be needed in kinetic calculations.

TABLE II
COMPUTER CODE INTERFACING

Descriptive Name	Function	Interface File Names	
		Data Supplied	Data Produced
1. <u>Cross-section Generator</u>	Generates from reference data (ENDF-B), or processed intermediate data, microscopic cross sections for broad-energy-group use in additional calculations.	ENDF-B	ISOTXS or BRKOKS, DLAYXS
2. <u>Cross-section Processor</u>	Converts microscopic cross sections from nuclide-ordered to neutron-group-ordered for dimensional neutronics calculations.	ISOTXS or BRKOKS	GRUPXS
3. <u>Neutronics</u>	Perform neutronics calculations in up to three-space dimensions using one of a number of theoretical approaches, e.g. finite-difference diffusion or S_N transport theory, synthesis.	GRUPXS GEODST NDXSRF ZNATDN SEARCH SNCONS FIXSRC RTFLUX	RTFLUX ATFLUX RCURNT ACURNT RAFLUX AAFLUX RZFLUX PWDINT GEODST FIXSRC ZNATDN
4. <u>Fuel-Cycle</u>	Time-dependent calculation of burn-up, fission product buildup, control rod and fuel assembly manipulations, and other fuel-cycle effects, closed loop interfacing with a neutronics code is required.	NDXSRF ZNATDN RZFLUX GRUPXS	NDXSRF ZNATDN SEARCH
5. <u>Perturbation</u>	Given regular and adjoint flux data perform first-order perturbation calculations to yield such information as prompt neutron lifetimes, effective delayed neutron fractions, and reactivities.	RTFLUX ATFLUX RCURNT ACURNT RAFLUX AAFLUX DLAYXS GEODST NDXSRF ZNATDN SNCONS GRUPXS	

All the new files will require implementation and testing in codes for a full evaluation. One new feature that must be tested is the variable blocking capability provided in the group cross-section files. By means of blocking parameters in the file specifications records, a programmer may control the number of blocks into which cross-section arrays are subdivided. Consequently, the content of individual records in the file can be varied to suit the characteristic dimensions of a particular cross-section file. The objective is to maintain I/O efficiency in the case of a small-dimension file without restricting the file capability for handling large dimensions. Variable blocking of all the large arrays in the files would have advantages. However, implementation of the capability implies considerable code modification and development. In addition, variable blocking can be accomplished in a variety of ways and to various degrees. Such policy questions are deferred for future consideration and development.

II. GENERAL COMMENTS ON THE USE OF THE FILES

Each file contains an identification record and a specifications record, followed by the records containing the file data. A typical identification record is shown below. HNAME is the generic name of

obtained from a subroutine call to SNIFF or SEEK, such as

```
CALL SEEK(FILNAM, HUSE, IVERS, N1, N2).
```

SEEK would retrieve N1 from a table that associates file names and versions with logical unit numbers. In addition, SEEK could position the logical unit correctly for reading or writing the desired file when more than one file is stacked on the unit. This could be accomplished by a succession of calls to the reading subroutine using

```
CALL REED(N1, IREC, A(1), 4, MODE).
```

(See Ref. 1 for more detailed descriptions of SEEK and REED). The REED calls would be repeated until a correspondence is obtained between the first four words of the A array and FILNAM, HUSE, and IVERS. In writing files, a record signifying the end of data would be required in order to avoid EOF tests. Such a record might include

```
ENDREC, HUSE, IVERS.
```

In the search procedure when ENDREC = 6HENDREC is found in A(1), SEEK would perform one BACKSPACE to position the logical unit for writing a new file on the unit.

The Specifications Record contains in one list all the dimensions and control flags required for reading the given file. This facilitates the use

C-----			
CR	IDENTIFICATION		-
C			-
CL	HNAME, (HUSE(1), I=1, 2), IVERS		-
C			-
CW	4		-
C			-
CD	HNAME	HOLLERITH FILE NAME - FILNAM - (A6)	-
CD	HUSE	HOLLERITH USER IDENTIFICATION (A6)	-
CD	IVERS	FILE VERSION NUMBER	-
C-----			

the file which in the example is taken to be FILNAM. HUSE provides for the possibility that more than one user's files may be stacked on the same logical unit. IVERS provides for the occasions where more than one version of a given type of file is required.

The uses to which the identification record would be put are not as yet completely specified. However, the logical unit number, N1, on which the file is to be read or written would presumably be

of the subroutine calls REED and RITE for reading or writing the file records, respectively. The argument lists in these subroutines must contain a specification of the total number of words NWDS to be transferred and a starting address, A(11), in core at which the transfer is to begin. Consequently, every record in the standard files has a CW entry which contains a number or an algorithm from which the number of words in the record can be computed. The algorithm is derived from the dimensions given in the Specifications Record.

A record may contain several arrays as in
 $(A1(I), I=1, L1), (A2(I), I=1, L2), \dots$

Let $I1, I2, \dots$ be the pointers locating the arrays $A1, A2, \dots$, respectively, in the container block A. Then the record is read using the following statements:

```

I2 = I1 + L1
I3 = I2 + L2
.
.
NWDS = L1 + L2 + ...
CALL REED(N), IREC, A(I1), NWDS, MODE)

```

Arrays are combined in records in the above manner in order to promote the efficiency of transfer of the file data.

A technique is introduced in the cross-section files for handling arrays which vary greatly in size, depending upon the application. For example, the array

$((B(I,J), I=1, IL), J=1, J1)$

containing $I1 \cdot J1$ words may be on occasion too large to store in core. Then the array could be transferred using NBLOK records, each containing the number of words

$NWES = I1 \cdot ((J1-1)/NBLOK + 1).$

The transfers would be accomplished using

```

DO n N=1,NBLOK
CALL REED(N1,IREC,A(1),NWDS,MODE)
.
.

```

Manipulations with block N

n CONTINUE

In the application to the cross-section files, the above technique is proposed for the formation of macroscopic cross sections from microscopic data where a very large number of groups is involved. Other large arrays in the files might be handled similarly, but a large amount of code development work would be involved in the implementation of this approach.

The original MULTIGRP nuclear data file has been split into four separate files, including both nuclide-ordered and group-ordered microscopic neutron cross-section files and separate files for the delayed neutron and Bondarenko data. Cross sections need to be ordered by nuclide for library applications, but group ordering is more convenient for code applications. In multidimensional flux codes and in other codes, the macroscopic cross-section data are stored by group to conserve core space. Thus, retrieval of cross sections stored by group should be more convenient and economical. Sorting of the cross sections by group would still be required when they are retrieved from a library or a processing code, but this sorting would need to be done only once rather than being done in effect each time the cross-section interface file is accessed by a code.

The delayed neutron and Bondarenko data are placed in separate files to provide more convenient access for the limited number of codes that require these data.

The original GRPFLX file containing flux code output has been separated into six files. Three of the files contain the regular total flux, current, and angular flux, and three additional files are defined for the associated adjoint data. This segregation of the data permits the adjoint files to be of different structure than the regular files and facilitates sorting of the data.

Considering that, in some applications, several versions of some of the files may exist, the total number of files involved becomes large. This apparently causes no difficulty on some computers but could be prohibitive on others. Consequently, the promulgation of this large number of files is based on an assumption that file handling coding techniques will be evolved that will provide options for arbitrarily stacking files on logical units. A procedure for automatically positioning a logical unit on a specified file among a stacked set using the SEEK routine was discussed above. In addition, a means of controlling the stacking optionally still needs to be evolved and tested.

III. THE STANDARD INTERFACE FILES

Presented below are the Standard Files with associated explanatory comments.

A. ISOTXS

This file is intended as the basic multigroup library. The isotope ordering permits easy addition to the file from a processing code. Three blocking factors are included in order to accommodate large sets while maintaining the desirable feature of few records per isotope (minimum of three) for more normal sets. It is expected that

the vast majority of cross-section sets will not require multiple blocks. Use of a blocking factor, $N > 1$, produces N records, each containing data for a partial energy group range. If the number of groups is not a multiple of N , the last record will contain some undefined words.

The identified entries in the principal cross-section record are intended to cover most practical situations. Additions to or deletions from this list would be extremely simple.

```

C*****
C                                     PREPARED 3/15/71
C
CF          ISOTXS
CE          MICROSCOPIC GROUP NEUTRON CROSS SECTIONS
C
CN          THIS FILE PROVIDES A BASIC BROAD GROUP
CN          LIBRARY, ORDERED BY ISOTOPE
C
C*****

```

```

C-----
CS          FILE STRUCTURE
CS
CS          RECORD TYPE                      PRESENT IF
CS          =====
CS          FILE IDENTIFICATION              ALWAYS
CS          FILE CONTROL                     ALWAYS
CS          FILE DATA                       ALWAYS
CS          ***** (REPEAT FROM 1 TO NCBLOK)
CS          *      SET CHI DATA              NCBLOK.GT.1
CS          *****
CS          ***** (REPEAT FOR ALL ISOTOPES)
CS          *      ISOTOPE CONTROL AND GROUP
CS          *      INDEPENDENT DATA          ALWAYS
CS          *      PRINCIPAL CROSS SECTIONS   ALWAYS
CS          *      ***** (REPEAT FROM 1 TO NCIBLK)
CS          *      ISOTOPE CHI DATA          IF15.GT.0.AND.1CHI.
CS          *      *                          GT.0.AND.NCIBLK.GT.1
CS          *      *****
CS          *      ***** (REPEAT TO NSCMAX SCATTERING BLOCKS)
CS          *      *      ***** (REPEAT FROM 1 TO NSBLOK)
CS          *      *      SCATTERING SUB-BLOCK LORD(N).GT.0)
CS          *****
C
C-----

```

```

C-----
CR          FILE IDENTIFICATION
C
CL          HNAME,(HUSE(I),I=1,2),IVERS
C
CW          4
C
CD          HNAME          HOLLERITH FILE NAME - ISOTXS - (A6)
CD          HUSE           HOLLERITH USER IDENTIFICATION (A6)
CD          IVERS          FILE VERSION NUMBER
C
C-----

```

```

C-----
CR          FILE CONTROL
C
CL      NNGROUP,NISO,MAXUP,MAXDN,MAXORD,ICHIST,NSCMAX,NCBLOK,NSBLOK
C
CW      9
C
CD      NNGROUP      NUMBER OF ENERGY GROUPS IN SET
CD      NISO         NUMBER OF ISOTOPES IN SET
CD      MAXUP        MAXIMUM NUMBER OF UPSCATTER GROUPS
CD      MAXDN        MAXIMUM NUMBER OF DOWNSCATTER GROUPS
CD      MAXORD       MAXIMUM SCATTERING ORDER
CD      ICHIST       SET FISSION SPECTRUM FLAG
CD                  ICHIST=1,      SET VECTOR
CD                  =NNGROUP, SET MATRIX
CD      NSCMAX       MAXIMUM NUMBER OF BLOCKS OF SCATTERING DATA
CD      NCBLOK       BLOCKING CONTROL FOR SET CHI DATA. IF NCBLOK
CD                  IS GREATER THAN 1, THE CHI DATA ARE BLOCKED
CD                  INTO NCBLOK RECORDS.
CD      NSBLOK       BLOCKING CONTROL FOR SCATTER MATRICES. THE
CD                  SCATTERING DATA ARE BLOCKED INTO NSBLOK
CD                  RECORDS PER SCATTERING BLOCK.
C
C-----

```

```

C-----
CR          FILE DATA
C
CL      (MSETID(I),I=1,12),(HISONM(I),I=1,NISO),
CL      1((CHI(I,J),I=1,ICHIST),J=1,NNGROUP),(VEL(J),J=1,NNGROUP),
CL      2(FMAX(J),J=1,NNGROUP),EMIN,(LOCA(I),I=1,NISO)
C
CW      (ICHIST*(1/NCBLOK)*2)*NNGROUP*2*NISO+13
C
CD      MSETID       HOLLERITH IDENTIFICATION OF SET (A6)
CD      HISONM(I)    HOLLERITH ISOTOPE LABEL FOR ISOTOPE I (A6)
CD      CHI(I,J)     SET FISSION SPECTRUM (PRESENT IF NCBLOK.EQ.1)
CD                  IF ICHIST=1, FRACTION FROM FISSION IN ANY GROUP
CD                  EMITTED IN GROUP J
CD                  IF ICHIST=NNGROUP, FRACTION FROM FISSION IN
CD                  GROUP I, EMITTED IN GROUP J
CD      VEL(J)       MEAN NEUTRON VELOCITY IN GROUP J (CM/SEC)
CD      EMAX(J)      MAXIMUM ENERGY BOUND OF GROUP J (EV)
CD      EMIN         MINIMUM ENERGY BOUND OF SET (EV)
CD      LOCA(I)      NUMBER OF RECORDS TO BE SKIPPED TO READ DATA FOR
CD                  ISOTOPE I. LOCA(1)=0
C
C-----

```

```

C-----
CR          SET CHI DATA
C
CC      PRESENT IF NCBLOK.GT.1
C
CL      ((CHI(I,J),I=1,ICHIST),J=JL,JU)
C
CC      IF M IS THE INDEX OF THE CHI SUB-BLOCK, THEN
CC      JL=(M-1)*((NNGROUP-1)/NCBLOK+1)+1
CC      AND JU=M*((NNGROUP-1)/NCBLOK+1)
C
CW      ICHIST*((NNGROUP-1)/NCBLOK+1)
C
C-----

```

```

C-----
CR      ISOTOPE CONTROL AND GROUP INDEPENDENT DATA
C
CL      HABSID,AMASS,EFISS,TEMP,SIGPOT,ADENS,KBR,NCIBLK,ICHI,IFIS,IALF,
CL      1INP,IN2N,IND,INT,(IOSCT(N),N=1,NSCMAX),(LORD(N),N=1,NSCMAX)
CL      2((JBAND(J,N),J=1,NGROUP),N=1,NSCMAX),
CL      3((IJJ(J,N),J=1,NGROUP),N=1,NSCMAX)
C
CW      (2*NGROUP+2)*NSCMAX+15
C
CD      HABSID      HOLLERITH ABSOLUTE ISOTOPE LABEL - SAME FOR ALL
CD                      VERSIONS OF THE SAME ISOTOPE IN SET (A6)
CD      AMASS      GRAM ATOMIC WEIGHT
CD      EFISS      TOTAL THERMAL ENERGY YIELD/FISSION (W.SEC/FISS)
CD      TEMP      ISOTOPE TEMPERATURE (DEGREES KELVIN)
CD      SIGPOT      AVERAGE EFFECTIVE POTENTIAL SCATTERING IN
CD                      RESONANCE RANGE (BARN/ATOM)
CD      ADENS      DENSITY OF ISOTOPE IN MIXTURE IN WHICH ISOTOPE
CD                      CROSS SECTIONS WERE GENERATED (A/BARN.CM)
CD      KBR      ISOTOPE CLASSIFICATION
CD                      0=UNDEFINED
CD                      1=FISSILE
CD                      2=FERTILE
CD                      3=OTHER ACTINIDE
CD                      4=FISSION PRODUCT
CD                      5=STRUCTURE
CD                      6=COOLANT
CD                      7=CONTROL
CD      NCIBLK      BLOCKING CONTROL FOR ISOTOPE CHI DATA. IF NCIBLK
CD                      IS GREATER THAN 1, THE CHI DATA ARE BLOCKED
CD                      INTO NCIBLK RECORDS
CD      ICHI      ISOTOPE FISSION SPECTRUM FLAG
CD                      ICHI=0, USE SET CHI
CD                      =1, ISOTOPE CHI VECTOR
CD                      =NGROUP, ISOTOPE CHI MATRIX
CD      IFIS      (N,F) CROSS SECTION FLAG
CD                      IFIS=0, NO FISSION DATA IN PRINCIPAL CROSS
CD                      SECTION RECORD
CD                      =1, FISSION DATA PRESENT IN PRINCIPAL
CD                      CROSS SECTION RECORD
CD      IALF      (N,ALPHA) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      INP      (N,P) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      IN2N      (N,2N) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      IND      (N,D) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      INT      (N,T) CROSS SECTION FLAG
CD                      SAME OPTIONS AS IFIS
CD      IOSCT(N)      SCATTERING MATRIX TYPE IDENTIFICATION FOR
CD                      SCATTERING BLOCK N. SIGNIFICANT ONLY IF
CD                      LORD(N).GT.0
CD                      IOSCT(N)=000 + NN, TOTAL SCATTERING
CD                      =100 + NN, ELASTIC SCATTERING
CD                      =200 + NN, INELASTIC SCATTERING
CD                      =300 + NN, (N,2N) SCATTERING PER EMITTED-
CD                      NEUTRON,
CD                      WHERE NN IS THE LEGENDRE EXPANSION INDEX OF THE
CD                      FIRST MATRIX IN BLOCK N
CD      LORD(N)      NUMBER OF SCATTERING ORDERS IN BLOCK N. IF
CD                      LORD(N)=0, THIS BLOCK IS NOT PRESENT FOR THIS
CD                      ISOTOPE. IF NN IS THE VALUE TAKEN FROM
CD                      IOSCT(N), THEN THE MATRICES IN THIS BLOCK
CD                      HAVE LEGENDRE EXPANSION INDICES OF NN,NN+1,
CD                      NN+2,...,NN+LORD(N)-1
CD      JBAND(J,N)      SCATTERING BANDWIDTH FOR GROUP J, SCATTERING
CD                      BLOCK N
CD      IJJ(J,N)      POSITION OF IN-GROUP SCATTERING CROSS SECTION IN
CD                      SCATTERING DATA FOR GROUP J, SCATTERING BLOCK
CD                      N,COUNTED FROM THE FIRST WORD OF GROUP J DATA.
C-----

```

```

C-----
CR      PRINCIPAL CROSS SECTIONS
C
CL      (STRSN(J),J=1,NGROUP),(STRDIF(J),J=1,NGROUP),
CL      1(STOT(J),J=1,NGROUP),(SNGAM(J),J=1,NGROUP),
CL      2(SFIS(J),J=1,NGROUP),(SNUTOT(J),J=1,NGROUP),
CL      3(CHISO(K,J),K=1,ICHI),J=1,NGROUP),(SNALF(J),J=1,NGROUP),
CL      4(SNP(J),J=1,NGROUP),(SN2N(J),J=1,NGROUP),
CL      5(SND(J),J=1,NGROUP),(SNT(J),J=1,NGROUP)
C
CW      (4+IFIS*(ICHI*(1/NCIBLK)+2)*IALF+INP+IN2N+IND+INT)*NGROUP
C
CD      STRSN      TRANSPORT FOR ISOTROPIC SN CALCULATIONS
CD      STRDIF     TRANSPORT FOR DIFFUSION THEORY
CD      STOT       TOTAL
CD      SNGAM      (N,GAMMA)
CD      SFIS       (N,F)      (PRESENT IF IFIS.GT.0)
CD      SNUTOT     TOTAL NEUTRON YIELD/FISSION (PRESENT IF IFIS.GT.0)
CD      CHISO      ISOTOPE CHI (PRESENT IF IFIS.GT.0.AND.ICHI.GT.0
CD                      .AND.NCIBLK.EQ.1)
CD                      IF ICHI=1, FRACTION FROM FISSION IN ANY GROUP
CD                      EMITTED IN GROUP J
CD                      IF ICHI=NGROUP, FRACTION FROM FISSION IN GROUP
CD                      K, EMITTED IN GROUP J
CD      SNALF      (N,ALPHA)   (PRESENT IF IALF.GT.0)
CD      SNP        (N,P)      (PRESENT IF INP.GT.0)
CD      SN2N       (N,2N)     (PRESENT IF IN2N.GT.0)
CD      SND        (N,D)      (PRESENT IF IND.GT.0)
CD      SNT        (N,T)      (PRESENT IF INT.GT.0)
C-----

```

```

C-----
CR      ISOTOPE CHI DATA
C
CC      PRESENT IF IFIS.GT.0.AND.ICHI.GT.0.AND.NCIBLK.GT.1
C
CL      ((CHISO(K,J),K=1,ICHI),J=JL,JU)
C
CC      IF M IS THE INDEX OF THE CHI SUB-BLOCK, THEN
CC      JL=(M-1)*((NGROUP-1)/NCIBLK+1)+1
CC      AND JU=M*((NGROUP-1)/NCIBLK+1)
C
CW      ICHI*((NGROUP-1)/NCIBLK+1)
C-----

```

```

C-----
CR      SCATTERING SUB-BLOCK
C
CC      PRESENT IF LORD(N).GT.0
C
CL      ((SCAT(K,L),K=1,KMAX),L=1,LORDN)
C
CC      KMAX=SUM OVER J OF JBAND(J) WITHIN THE J-GROUP RANGE OF THIS
CC      SUB-BLOCK. IF M IS THE INDEX OF THE SUB-BLOCK, THE J-GROUP
CC      RANGE CONTAINED WITHIN THIS SUB-BLOCK IS
CC      JL=(M-1)*((NGROUP-1)/NSBLOK+1)+1 TO JU=M*((NGROUP-1)/NSBLOK+1)
CC      LORDN=LORD(N)
C
CW      KMAX=LORDN
C

```

```

CD      SCAT(K,L)      SCATTERING MATRIX OF SCATTERING ORDER L. FOR -
CD                      REACTION TYPE IDENTIFIED BY IDSCT(I) FOR THIS -
CD                      BLOCK. JBAND(J) VALUES FOR SCATTERING INTO -
CD                      GROUP J ARE STORED AT LOCATIONS K=SUM FROM 1 -
CD                      TO (J-1) OF JBAND(1) PLUS 1 TO K+JBAND(J). THE -
CD                      SUM IS ZERO WHEN J=1. J-TO-J SCATTER IS -
CD                      THE IJJ(J)-TH ENTRY IN THE RANGE JBAND(J). -
CD                      VALUES ARE STORED IN THE ORDER (J*MAXUP), -
CD                      (J*MAXUP+1),...,(J+1),J,(J-1),...,(J-MAXDN), -
CD                      WHERE MAXUP=IJJ(J)-1 AND MAXDN=JBAND(J)-IJJ(J) -
C-----

```

CEOF

B. GRUPXS

This file contains the same data as ISOTXS, but ordered by energy group. It is expected that this file will be produced from ISOTXS by a conversion module, then the other modules will access GRUPXS for further calculations.

Blocking factors are provided to allow separation of the file into subfiles, each containing all data for one or more isotopes. For few-group ordinary INFBR applications, data for all isotopes and a single group can be entered in three records.

```

C*****
C                      PREPARED 3/15/71
C
CF      GRUPXS
CE      MICROSCOPIC GROUP NEUTRON CROSS SECTIONS
C
CN      THIS FILE PROVIDES A BASIC BROAD GROUP
CN      LIBRARY, ORDERED BY GROUP
C-----

```

```

C-----
CS      FILE STRUCTURE
CS
CS      RECORD TYPE      PRESENT IF
CS      *****
CS      FILE IDENTIFICATION  ALWAYS
CS      FILE CONTROL        ALWAYS
CS      FILE DATA          ALWAYS
CS      *****
CS      * (REPEAT FROM 1 TO NCHLCK)
CS      * SET CHI DATA      NCHLCK.GT.1
CS      *
CS      * (REPEAT FROM 1 TO NIBLCK)
CS      * ISOTOPE CONTROL AND GROUP
CS      * INDEPENDENT DATA  ALWAYS
CS      * *****
CS      * * (REPEAT FOR ALL GROUPS)
CS      * * PRINCIPAL CROSS SECTIONS  ALWAYS
CS      * * *****
CS      * * * (REPEAT FROM 1 TO NCIBLK)
CS      * * * ISOTOPE CHI DATA      IFIS.GT.0.AND.ICHI.
CS      * * *                   GT.0.AND.NCIBLK.GT.1
CS      * * *
CS      * * SCATTERING CONTROL  ALWAYS
CS      * * *****
CS      * * * (REPEAT TO NSCMAX SCATTERING BLOCKS)
CS      * * * * (REPEAT FROM 1 TO NSBLCK)
CS      * * * * SCATTERING SUB-BLOCK  LORD(1).GT.0)
CS      * * * *
C-----

```

```

C-----
CR          FILE IDENTIFICATION
C
CL      HNAME, (HUSE(1),I=1,2), IVERS
C
CM      4
C
CD      HNAME          HOLLERITH FILE NAME - GRUPAS - (A6)
CD      HUSE           HOLLERITH USER IDENTIFICATION (A6)
CD      IVERS          FILE VERSION NUMBER
C-----

```

```

C-----
CR          FILE CONTROL
C
CL      NGROUP, NISO, NARUP, NARON, NARORD, ICHIST, NSCMAX, NCBLOCK, NIBLOCK,
CL      NCBLOCK
C
CM      20
C
CD      NGROUP          NUMBER OF ENERGY GROUPS IN SET
CD      NISO            NUMBER OF ISOTOPE IN SET
CD      NARUP           MAXIMUM NUMBER OF UPSCATTER GROUPS
CD      NARON           MAXIMUM NUMBER OF DOWNSCATTER GROUPS
CD      NARORD          MAXIMUM SCATTERING ORDER
CD      ICHIST          SET FISSION SPECTRUM FLAG
CD                      ICHIST=1,      SET VECTOR
CD                      *NGROUP, SET MATRIX
CD      NSCMAX          MAXIMUM NUMBER OF BLOCKS OF SCATTERING DATA
CD      NCBLOCK         BLOCKING CONTROL FOR SET CHI DATA. IF NCBLOCK
CD                      IS GREATER THAN 1, THE CHI DATA ARE BLOCKED
CD                      INTO NCBLOCK RECORDS.
CD      NIBLOCK         BLOCKING CONTROL FOR SET. NUMBER OF ISOTOPE
CD                      BLOCKS INTO WHICH FILE IS SEPARATED
CD                      (1.LE.NIBLOCK.LE.NISO)
CD      NCBLOCK         BLOCKING CONTROL FOR SCATTER MATRICES. THE
CD                      SCATTERING DATA ARE BLOCKED INTO NCBLOCK
CD                      RECORDS PER SCATTERING BLOCK.
C-----

```

```

C-----
CR          FILE DATA
C
CL      (HSETID(1),I=1,2), (HISONH(1),I=1,NISO),
CL      1 (ICH(IX,J),X=1, ICHIST), J=1,NGROUP), (VEL(J),J=1,NGROUP),
CL      2 (FMAX(J),J=1,NGROUP), EMIN, (NISOBIN), N=1,NIBLOCK),
CL      3 (OCA(N),N=1,NIBLOCK)
C
CM      (ICHIST*(1/NCBLOCK)+2)*NGROUP+NISO+2*NIBLOCK+13
C
CD      HSETID          HOLLERITH IDENTIFICATION OF SET (A6)
CD      HISONH(1);      HOLLERITH ISOTOPE LABEL FOR ISOTOPE 1 (A6)
CD      CHI(1,J)        SET FISSION SPECTRUM (PRESENT IF NCBLOCK.EQ.1)
CD                      IF ICHIST=1, FRACTION FROM FISSION IN ANY GROUP
CD                      EMITTED IN GROUP J
CD                      IF ICHIST=NGROUP, FRACTION FROM FISSION IN
CD                      GROUP K, EMITTED IN GROUP J
CD      VFL(J)          MEAN NEUTRON VELOCITY IN GROUP J (CM/SEC)
CD      EMAX(J)          MAXIMUM ENERGY ROUND OF GROUP J (EV)
CD      EMIN            MINIMUM ENERGY ROUND OF SET (EV)
CD      NISOBIN          NUMBER OF ISOTOPE IN BLOCK N.
CD                      (1.LE.NISOBIN.LE.(NISO-NIBLOCK+1))
CD      LOCA(I)         NUMBER OF RECORDS TO BE SKIPPED TO READ DATA
CD                      FROM START OF BLOCK N. LOCA(I)=0
C-----

```

```

C-----
CR      SET CHI DATA
C
CC      PRESENT IF NCBLK.GT.1
C
CL      ((CH(1,J),J=1,ICHIST),J=JL,JU)
C
CC      IF M IS THE INDEX OF THE CHI SUB-BLOCK, THEN
CC      JL=(M-1)*(NGROUP-1)/NCBLK+1
CC      AND JU=M*(NGROUP-1)/NCBLK+1
C
CW      ICHIST*(NGROUP-1)/NCBLK+1
C
C-----

```

```

C-----
CR      ISOTOPE CONTROL AND GROUP INDEPENDENT DATA
C
CL      (HABSID(I),I=1,NISON),(AMASS(I),I=1,NISON),(EFISS(I),I=1,NISON),
CL      ITEMP(I),I=1,NISON),(SIGPOT(I),I=1,NISON),(ADENS(I),I=1,NISON),
CL      2*(BR(I),I=1,NISON),(IOSCT(N),N=1,NSCHMAX),(LORD(N),N=1,NSCHMAX),
CL      3*NCIBLK,ICH1,IFIS,IALF,INP,IN2N,IND,INT
C
CC      NISON=NISOB(N)
C
CW      7*NISON+2*NSCHMAX+8
C
CD      HABSID(I)      HOLLERITH ABSOLUTE ISOTOPE LABEL FOR THE I-TH
CD                      ISOTOPE IN BLOCK N. THIS ISOTOPE HAS THE NAME
CD                      NISONH(K), WHERE K=SUM OVER L FROM 1 TO N-1 OF
CD                      NISOB(L), PLUS 1.
CD      AMASS(I)        GRAM ATOMIC WEIGHT
CD      EFISS(I)        TOTAL THERMAL ENERGY YIELD/FISSION (W.SEC/FISS)
CD      ITEMP(I)        ISOTOPE TEMPERATURE (DEGREES KELVIN)
CD      SIGPOT(I)       AVERAGE EFFECTIVE POTENTIAL SCATTERING IN
CD                      RESONANCE RANGE (BARNS/ATOM)
CD      ADENS(I)        DENSITY OF ISOTOPE IN MIXTURE IN WHICH ISOTOPE
CD                      CROSS SECTIONS WERE GENERATED (A/BARN.CM)
CD      KNR(I)          ISOTOPE CLASSIFICATION
CD                      0=UNDEFINED
CD                      1=FISSILE
CD                      2=FERTILE
CD                      3=OTHER ACTINIDE
CD                      4=FISSION PRODUCT
CD                      5=STRUCTURE
CD                      6=COOLANT
CD                      7=CONTROL
CD      IOSCT(N)        SCATTERING MATRIX TYPE IDENTIFICATION FOR
CD                      SCATTERING BLOCK N. SIGNIFICANT ONLY IF
CD                      LORD(N).GT.0
CD                      IOSCT(N)=000 * NN, TOTAL SCATTERING
CD                      =100 * NN, ELASTIC SCATTERING
CD                      =200 * NN, INELASTIC SCATTERING
CD                      =300 * NN, (N,2N) SCATTERING PER EMITTED-
CD                      NEUTRON
CD                      WHERE NN IS THE LEGENDRE EXPANSION INDEX OF THE
CD                      FIRST MATRIX IN BLOCK N
CD      LORD(N)         NUMBER OF SCATTERING ORDERS IN BLOCK N. IF
CD                      LORD(N)=0, THIS BLOCK IS NOT PRESENT FOR THIS
CD                      ISOTOPE BLOCK. IF NN IS THE VALUE TAKEN FROM
CD                      IOSCT(N), THEN THE MATRICES IN THIS BLOCK
CD                      HAVE LEGENDRE EXPANSION INDICES OF NN,NN+1,
CD                      NN+2,...,NN+LORD(N)-1
CD      NCIBLK          BLOCKING CONTROL FOR ISOTOPE CHI DATA. IF NCIBLK
CD                      IS GREATER THAN 1, THE CHI DATA ARE BLOCKED
CD                      INTO NCIBLK RECORDS
CD      ICHI            ISOTOPE FISSION SPECTRUM FLAG
CD                      ICHI=0, USE SET CHI
CD                      =1, ISOTOPE CHI VECTOR
CD                      =NGROUP, ISOTOPE CHI MATRIX
C
C-----

```

```

CD   IFIS      (N,F) CROSS SECTION FLAG
CD           IFIS=0, NO FISSION DATA IN PRINCIPAL CROSS
CD           SECTION RECORD
CD           =1, FISSION DATA PRESENT IN PRINCIPAL
CD           CROSS SECTION RECORD
CD   IALF      (N,ALPHA) CROSS SECTION FLAG
CD           SAME OPTIONS AS IFIS
CD   INP        (N,P) CROSS SECTION FLAG
CD           SAME OPTIONS AS IFIS
CD   IN2N      (N,2N) CROSS SECTION FLAG
CD           SAME OPTIONS AS IFIS
CD   IND        (N,D) CROSS SECTION FLAG
CD           SAME OPTIONS AS IFIS
CD   INT        (N,T) CROSS SECTION FLAG
CD           SAME OPTIONS AS IFIS
C
C-----

```

```

C-----
CR      PRINCIPAL CROSS SECTIONS
C
CL      (STRSN(I),I=1,NISON),(STRDIF(I),I=1,NISON),
CL      1(STOT(I),I=1,NISON),(SNGAM(I),I=1,NISON),
CL      2SFIS(I),I=1,NISON),(SNUTOT(I),I=1,NISON),
CL      3((CHIISO(K,I),K=1,ICHI),I=1,NISON),(SNALF(I),I=1,NISON),
CL      4(SNP(I),I=1,NISON),(SN2N(I),I=1,NISON),
CL      5(SND(I),I=1,NISON),(SNT(I),I=1,NISON)
C
CC      NISON=NISOB(N)
C
CW      (4*IFIS*(ICHI*(1/NCIBLK)+2)+IALF*INP*IN2N*IND*INT)*NISON
C
CD      STRSN      TRANSPORT FOR ISOTROPIC SN CALCULATIONS
CD      STRDIF     TRANSPORT FOR DIFFUSION THEORY
CD      STOT       TOTAL
CD      SNGAM      (N,GAMMA)
CD      SFIS       (N,F)      (PRESENT IF IFIS.GT.0)
CD      SNUTOT     TOTAL NEUTRON YIELD/FISSION (PRESENT IF IFIS.GT.0)
CD      CHIISO     ISOTOPE CHI (PRESENT IF IFIS.GT.0.AND.ICHI.GT.0
CD                      .AND.NCIBLK.EQ.1)
CD                      IF ICHI=1, FRACTION FROM FISSION IN ANY GROUP
CD                      EMITTED IN GROUP J
CD                      IF ICHI=NGROUP, FRACTION FROM FISSION IN GROUP
CD                      K, EMITTED IN GROUP J
CD      SNALF      (N,ALPHA)   (PRESENT IF IALF.GT.0)
CD      SNP        (N,P)      (PRESENT IF INP.GT.0)
CD      SN2N       (N,2N)     (PRESENT IF IN2N.GT.0)
CD      SND        (N,D)      (PRESENT IF IND.GT.0)
CD      SNT        (N,T)      (PRESENT IF INT.GT.0)
C
C-----

```

```

C-----
CR      ISOTOPE CHI DATA
C
CC      PRESENT IF IFIS.GT.0.AND.ICHI.GT.0.AND.NCIBLK.GT.1
C
CL      ((CHIISO(K,I),K=1,ICHI),I=1L,IU)
C
CC      IF M IS THE INDEX OF THE CHI SUB-BLOCK, THEN
CC      IL=(M-1)*((NISON-1)/NCIBLK+1)+1
CC      AND IU=M*((NISON-1)/NCIBLK+1)
C
CW      ICHI*((NISON-1)/NCIBLK+1)
C
C-----

```



```

C-----
CR          SCATTERING CONTROL
C
CL      ((JBAND(I,N),I=1,NISON),N=1,NSCMAX)
CL      I((IJJ(I,N),I=1,NISON),N=1,NSCMAX)
C
CC      NISON=NISOB(N)
C
CW      NISON=NSCMAX
C
CD      JBAND(I,N)    SCATTERING BANDWIDTH FOR ISOTOPE I, SCATTERING
CD                      BLOCK N
CD      IJJ(I,N)      POSITION OF IN-GROUP SCATTERING CROSS SECTION IN
CD                      SCATTERING DATA FOR ISOTOPE I, SCATTERING BLOCK
CD                      N,COUNTED FROM THE FIRST WORD OF ISOTOPE I DATA
C
C-----

```

```

C-----
CR          SCATTERING SUB-BLOCK
C
CC          PRESENT IF LORD(N).GT.0
C
CL      ((SCAT(K,L),K=1,KMAX),L=1,LORDN)
C
CC      KMAX=SUM OVER I OF JBAND(I,N).
CC      LORDN=LORD(N)
C
CW      KMAX=LORDN
C
CD      SCAT(K,L)      SCATTERING MATRIX OF SCATTERING ORDER L, FOR
CD                      REACTION TYPE IDENTIFIED BY IDSCT(N) FOR THIS
CD                      BLOCK. JBAND(I) VALUES FOR SCATTERING INTO
CD                      GROUP J ARE STORED AT LOCATIONS K=SUM FROM 1
CD                      TO (I-1) OF JBAND(I) PLUS 1 TO K+JBAND(I). THE
CD                      SUM IS ZERO WHEN I=1. J-TO-J SCATTER IS
CD                      THE IJJ(I)-TH ENTRY IN THE RANGE JBAND(I).
CD                      VALUES ARE STORED IN THE ORDER (J+MAXUP),
CD                      (J+MAXUP-1),....,(J+1),J,(J-1),....,(J-MAXDN),
CD                      WHERE MAXUP=IJJ(I)-I AND MAXDN=JBAND(I)-IJJ(I)
C
C-----

```

CEOF

C. DLAYXS

This file provides the delayed neutron data reduced to multigroup form. The individual data blocks are related to cross-section files in ISOTXS

and GRUPXS by the absolute isotope label. The set energy boundaries are included in this file to provide a consistency check with file ISOTXS (or GRUPXS).

```

C*****
C              PREPARED 3/15/71
C
C          DLAYXS
CE      MICROSCOPIC GROUP DELAYED NEUTRON PRECURSOR DATA
C
CN          THIS FILE PROVIDES PRECURSOR YIELDS,
CN          EMISSION SPECTRA, AND DECAY CONSTANTS
CN          ORDERED BY ISOTOPE. ISOTOPES ARE IDENTIFIED
CN          BY ABSOLUTE ISOTOPE LABELS FOR RELATION TO
CN          ISOTOPES IN EITHER FILE ISOTXS OR GRUPXS.
C
C*****

```

```

C-----
CS          FILE STRUCTURE
CS
CS          RECORD TYPE                      PRESENT IF
CS          *****
CS          FILE IDENTIFICATION              ALWAYS
CS          FILE CONTROL                     ALWAYS
CS          FILE DATA, DECAY CONSTANTS, AND
CS          EMISSION SPECTRA                 ALWAYS
CS          ***** (REPEAT TO NISOD)
CS          * DELAYED NEUTRON PRECURSOR
CS          * YIELD DATA                     ALWAYS
CS          *****
C
C-----

```

```

C-----
CR          FILE IDENTIFICATION
C
CL          HNAME, (HUSE(I), I=1,2), IVERS
C
CW          4
C
CD          HNAME      HOLLERITH FILE NAME - DLAYXS -
CD          HUSE       HOLLERITH USER IDENTIFICATION
CD          IVERS      FILE VERSION NUMBER
C
C-----

```

```

C-----
CR          FILE CONTROL
C
CL          NGROUP, NISOD, NFAM, IDUM
C
CW          4
C
CD          NGROUP     NUMBER OF NEUTRON ENERGY GROUPS IN SET
CD          NISOD      NUMBER OF ISOTOPES IN DELAYED NEUTRON SET
CD          NFAM       NUMBER OF DELAYED NEUTRON FAMILIES IN SET
CD          IDUM       DUMMY TO MAKE UP FOUR WORD RECORD,
C
C-----

```

```

C-----
C
CR          FILE DATA, DECAY CONSTANTS, AND EMISSION SPECTRA
C
CL      (MABSID(I),I=1,NISOD),(FLAM(N),N=1,NFAM),(CHID(J,N),J=1,NGROUP),
CL      N=1,NFAM),(EMAX(J),J=1,NGROUP),EMIN,(NKFAM(I),I=1,NISOD),
CL      (LOCA(I),I=1,NISOD)
C
CW      2*NISOD*(NGROUP+1)*(NFAM+1)
C
CD      MABSID(I)      HOLEWITH ABSOLUTE ISOTOPE LABEL FOR ISOTOPE I (A6)
CD      FLAM(N)        DELAYED NEUTRON PRECURSOR DECAY CONSTANT
CD                      FOR FAMILY N
CD      CHID(J,N)      FRACTION OF DELAYED NEUTRONS EMITTED INTO NEUTRON
CD                      ENERGY GROUP J FROM PRECURSOR FAMILY N
CD      EMAX(J)        MAXIMUM ENERGY BOUND OF GROUP J (eV)
CD      EMIN           MINIMUM ENERGY BOUND OF SET (eV)
CD      NKFAM(I)       NUMBER OF FAMILIES TO WHICH FISSION IN ISOTOPE I
CD                      CONTRIBUTES DELAYED NEUTRON PRECURSORS
CD      LOCA(I)        NUMBER OF RECORDS TO BE SKIPPED TO READ DATA FOR
CD                      ISOTOPE I. LOCA(I)=0
C
C-----

```

```

C-----
CR          DELAYED NEUTRON PRECURSOR YIELD DATA
C
CL      (SNUDEL(J,K),J=1,NGROUP),K=1,NKFAM),(NUMFAM(K),K=1,NKFAM)
C
CC      NKFAM=NKFAM(I)
C
CW      (NGROUP+1)*NKFAM
C
CD      SNUDEL(J,K)    NUMBER OF DELAYED NEUTRON PRECURSORS PRODUCED IN
CD                      FAMILY NUMBER NUMFAM(K) PER FISSION IN
CD                      GROUP J
CD      NUMFAM(K)      FAMILY NUMBER OF THE K-TH YIELD VECTOR IN
CD                      ARRAY SNUDEL(J,K)
C
C-----

```

CEOF

D. BRKXKS

This file is required in conjunction with an ISOTXS (or GRUPXS) file when the Bondarenko self-shielding method is to be used. The set energy boundaries are included to provide a consistency

check with the remaining cross-section data in file ISOTXS (or GRUPXS). The output of a processing code would be a self-shielded version of ISOTXS (or GRUPXS). Only those isotopes which have interpolation tables need be included in BRKXKS.

```

C*****
C          PREPARED 3/15/71
C
CF          BRKXKS
CE          BONDARENKO SELF-SHIELDING TABLES
C
CN          THIS FILE PROVIDES DATA NECESSARY FOR
CN          BONDARENKO TREATMENT IN ADDITION TO
CN          THOSE DATA IN FILE ISOTXS
C
C*****

```

```

C-----
CS      FILE STRUCTURE
CS
CS      RECORD TYPE
CS      =====
CS      FILE IDENTIFICATION
CS      FILE CONTROL
CS      FILE DATA
CS      ***** (REPEAT FROM 1 TO NISOSH)
CS      *      SELF-SHIELDING FACTORS
CS      *      CROSS SECTIONS
CS      *****
CS
C-----

```

```

C-----
CR      FILE IDENTIFICATION
C
CL      HNAMEF,(HUSE(I),I=1,2),IVERS
C
CW      4
C
CD      HNAME      HOLLERITH FILE NAME - BRK0XS - (A6)
CD      HUSE       HOLLERITH USER IDENTIFICATION (A6)
CD      IVERS      FILE VERSION NUMBER
C
C-----

```

```

C-----
CR      FILE CONTROL
C
CL      NGROUP,NISOSH,NSIGPT,NTEMPT
C
CW      4
C
CD      NGROUP     NUMBER OF ENERGY GROUPS IN SET
CD      NISOSH     NUMBER OF ISOTOPES WITH SELF-SHIELDING FACTORS
CD      NSIGPT     TOTAL NUMBER OF VALUES OF VARIABLE X (SEE FILE DATA-
CD                  RECORD) WHICH ARE GIVEN. NSIGPT IS EQUAL TO
CD                  THE SUM FROM 1 TO NISOSH OF NTABP(I)
CD      NTEMPT     TOTAL NUMBER OF VALUES OF VARIABLE TB (SEE FILE
CD                  DATA RECORD) WHICH ARE GIVEN. NTEMPT IS EQUAL
CD                  TO THE SUM FROM 1 TO NISOSH OF NTABT(I)
C
C-----

```

```

C-----
CR      FILE DATA
C
CL      (HISONM(I),I=1,NISOSH),(X(K),K=1,NSIGPT),(TB(K),K=1,NTEMPT),
CL      1(FMAX(J),J=1,NGROUP),EMIN,(JBFL(I),I=1,NISOSH),
CL      2(JBFH(I),I=1,NISOSH),(NTABP(I),I=1,NISOSH),(NTABT(I),I=1,NISOSH)
C
CW      5*NISOSH+NSIGPT+NTEMPT+NGROUP+1
C
CD      HISONM(I)   HOLLERITH ISOTOPE LABEL FOR ISOTOPE I (A6). THESE
CD                  LABELS MUST BE A SUBSET OF THOSE IN FILE ISOTXS
CD                  OR GRUPTS, IN THE CORRESPONDING ARRAY.
CD      X           ARRAY OF LN(SIGP0)/LN(10) VALUES FOR ALL ISOTOPES,
CD                  WHERE SIGP0 IS THE TOTAL CROSS SECTION OF THE
CD                  OTHER ISOTOPES IN THE MIXTURE IN BARNS PER ATOM
CD                  OF THIS ISOTOPE. FOR ISOTOPE I, THE NTABP(I)
CD                  VALUES OF X FOR WHICH SELF-SHIELDING FACTORS
CD                  ARE GIVEN ARE STORED STARTING AT LOCATION L=1+
CD                  SUM FROM 1 TO I-1 OF NTABP(K).
C
C-----

```

```

CD      TR          ARRAY OF TEMPERATURES (DEGREES C) FOR ALL ISOTOPES.-
CD                      FOR ISOTOPE I, THE NTBT(I) VALUES OF TB FOR
CD                      WHICH SELF-SHIELDING FACTORS ARE GIVEN ARE
CD                      STORED AT LOCATION L=1+SUM FROM 1 TO I-1 OF
CD                      NTABT(K).
CD      EMAX(J)     MAXIMUM ENERGY BOUND OF GROUP J (EV)
CD      EMIN        MINIMUM ENERGY BOUND OF SET (EV)
CD      JRFL        NUMBER OF LOWEST ENERGY GROUP FOR WHICH SELF-
CD                      SHIELDING FACTORS ARE GIVEN.
CD      JRFH        NUMBER OF HIGHEST ENERGY GROUP FOR WHICH SELF-
CD                      SHIELDING FACTORS ARE GIVEN.
CD      NTABP(I)    NUMBER OF SIGPO VALUES FOR WHICH SELF-SHIELDING
CD                      FACTORS ARE GIVEN FOR ISOTOPE I.
CD      NTABT(I)    NUMBER OF TEMPERATURE VALUES FOR WHICH SELF-
CD                      SHIELDING FACTORS ARE GIVEN FOR ISOTOPE I.
C
C-----

```

```

C-----
CR          SELF-SHIELDING FACTORS
C
CL      (( (FTOT(N,K,J),N=1,NBINT),K=1,NBTEM),J=JBFLI,JBFHI),
CL      (( (FCAP(N,K,J),N=1,NBINT),K=1,NBTEM),J=JBFLI,JBFHI),
CL      (( (FFIS(N,K,J),N=1,NBINT),K=1,NBTEM),J=JBFLI,JBFHI),
CL      (( (FTR (N,K,J),N=1,NBINT),K=1,NBTEM),J=JBFLI,JBFHI),
CL      (( (FEL (N,K,J),N=1,NBINT),K=1,NBTEM),J=JBFLI,JBFHI)
C
CC      NRINT=NTABP(I)
CC      NRTEM=NTABT(I)
CC      JRFLI=JBFL(I)
CC      JRFHI=JBFH(I)
C
CW      5*NBINT*NBTEM*(JBFHI-JBFLI+1)
C
CD      FTOT        TOTAL SELF-SHIELDING FACTOR EVALUATED AT
CD                      X(N) AND TB(K).
CD      FCAP        CAPTURE SELF-SHIELDING FACTOR EVALUATED AT
CD                      X(N) AND TB(K).
CD      FFIS        FISSION SELF-SHIELDING FACTOR EVALUATED AT
CD                      X(N) AND TB(K).
CD      FTR         TRANSPORT SELF-SHIELDING FACTOR EVALUATED AT
CD                      X(N) AND TB(K).
CD      FEL         ELASTIC SELF-SHIELDING FACTOR EVALUATED AT
CD                      X(N) AND TB(K).
C
C-----

```

```

C-----
CR          CROSS SECTIONS
C
CL      (XSP0(J),J=1,NGROUP),(XSIN(J),J=1,NGROUP),(XSE(J),J=1,NGROUP),
CL      1(XSMU(J),J=1,NGROUP),(XSED(J),J=1,NGROUP),(XSXI(J),J=1,NGROUP)
C
CW      6*NGROUP
C
CD      XSP0        POTENTIAL SCATTERING CROSS SECTION (BARNs)
CD      XSIN        INELASTIC CROSS SECTION (BARNs)
CD      XSE         ELASTIC CROSS SECTION (BARNs)
CD      XSMU        AVERAGE COSINE OF ELASTIC SCATTERING ANGLE
CD      XSED        ELASTIC DOWN-SCATTERING TO ADJACENT GROUP
CD      XSXI        AVERAGE ELASTIC SCATTERING LETHARGY INCREMENT
C
C-----

```

CEOF

E. GEODST

This file presents a geometric description for a neutronics problem. Up to three space traverses are given, orthogonal except in the case of triangular or hexagonal geometry. Boundary conditions are specified at each end of each traverse, and intervals are assigned. A region number is assigned to each geometric location contained within interval boundaries, and a zone number is assigned to each region. Thus, a zone consists of one or more regions, not necessarily adjacent, while a region is made up of one or more discrete volume elements, also not necessarily adjacent. (Discrete volume elements contained within one region could have identical volumes if desired, but this is not a requirement of the file specification.)

The parameter IGOM identifies a coordinate system. A zero value is for a point (fundamental mode), $1 \leq \text{IGOM} \leq 5$ is one dimensional, $6 \leq \text{IGOM} \leq 13$ is two dimensional, while $\text{IGOM} \geq 14$ specifies a three-dimensional system.

Relatively general boundary conditions are allowed, excepting any which would define a non-eigenvalue problem. These have been arranged to admit simple interpretation in both the diffusion and the discrete ordinates representations of neutron transport.

The file has provision for geometric bucklings to represent orthogonal dimensions not represented explicitly.

```

C * * * * * 10220
C 10230
C 10240
C PREPARED MARCH 21, 1971 -- REASSESSED AUGUST, 1971 10250
C 10260
C# GEODST 10270
C 10280
C# GEOMETRY DESCRIPTION 10290
C 10300
C * * * * * 10310
C 10320
C - - - - - 10330
C# IDENTIFICATION 10340
C 10350
C# HNAME,(HUSE(I),I=1,2),IVERS 10360
C 10370
C# HNAME HOLLERITH FILE NAME - GEODST - (A6) 10380
C# HUSE HOLLERITH USER IDENTIFICATION (A6) 10390
C# IVERS FILE VERSION NUMBER 10400
C 10410
C - - - - - 10420
C 10430
C - - - - - 10440
C# SPECIFICATIONS 10450
C 10460
C# IGOM, NZONE, NREG, NZCL, IM, JM, KM, IMBL, JMBT, IMBR, JMBB, KMBF, 10470
C# KMBR, NBS, NBCS, NIBCS, NZWBB, (NGOP(I),I=1,10) 10480
C 10490
C# IGOM GEOMETRY 0- POINT (FUNDAMENTAL MODE) 10500
C# 1- SLAB 10510
C# 2- CYLINDER 10520
C# 3- SPHERE 10530
C# 6- X-Y 10540
C# 7- R-Z 10550
C# 8- THETA-R 10560
C# 9- TRIAGONAL 10570
C# 10- HEXAGONAL 10580
C# 14- X-Y-Z 10590
C# 15- THETA-R-Z 10600
C# 16- THETA-R-ALPHA 10610
C# 17- TRIAGONAL-Z 10620
C# 18- HEXAGONAL-Z 10630

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CD	NZONE	NUMBER OF ZONES (EACH HOMOGENEOUS IN NEUTRONICS	10640
CD		PROBLEM - A ZONE CONTAINS ONE OR MORE REGIONS)	10650
CD	NREG	NUMBER OF REGIONS	10660
CD	NZCL	NUMBER OF ZONE CLASSIFICATIONS (EDIT PURPOSES)	10670
CD	IM	NUMBER OF FIRST DIMENSION INTERVALS	10680
CD	JM	NUMBER OF SECOND DIMENSION INTERVALS	10690
CD	KM	NUMBER OF THIRD DIMENSION INTERVALS	10700
CD	IMBL	LEFT BOUNDARY ON FIRST DIMENSION	10710
CD		0- ZERO FLUX (DIFFUSION)	10720
CD		1- REFLECTED	10730
CD		2- EXTRAPOLATED (DIFFUSION - $\Delta\Phi / \Phi =$	10740
CD		$C \cdot D$ WHERE C IS GIVEN AS BNDC BELOW AND D	10750
CD		IS THE GROUP DIFFUSION CONSTANT,	10760
CD		TRANSPORT - NO RETURN)	10770
CD		3- REPEATING (PERIODIC) WITH OPPOSITE FACE	10780
CD		4- REPEATING (PERIODIC) WITH NEXT ADJACENT	10790
CD		FACE GOING IN ORDER (90 DEGREE ROTATION)	10800
CD		5- INVERTED REPEATING ALONG THIS FACE	10810
CD		(180 DEGREE ROTATION)	10820
CD		6- ISOTROPIC RETURN (TRANSPORT)	10830
CD		(OTHER POSSIBILITIES CODE-DEPENDENT)	10840
C			10850
C		NOTE THAT FOR REPEATING BOUNDARIES, THE FIRST BOUNDARY IN	10860
C		ORDER WHICH IS INVOLVED CARRIES THE DESIGNATOR DEFINING	10870
C		THE REPEATING CONDITION.	10880
C			10890
CD	JMBT	TOP BOUNDARY ON SECOND DIMENSION	10900
CD	JMBR	RIGHT BOUNDARY ON FIRST DIMENSION	10910
CD	JMBB	BOTTOM BOUNDARY ON SECOND DIMENSION	10920
CD	KMBF	FRONT BOUNDARY ON THIRD DIMENSION	10930
CD	KMBR	REAR BOUNDARY ON THIRD DIMENSION	10940
CD	NBS	NUMBER OF BUCKLING SPECIFICATIONS	10950
CD		1- SINGLE VALUE APPLIES EVERYWHERE	10960
CD		.EQ.NZONE, ZONE-DEPENDENT	10970
CD		.GT.NZONE, DATA IS GIVEN OVER ALL ZONES FOR	10980
CD		THE FIRST ENERGY GROUP, THEN FOR THE NEXT	10990
CD		GROUP, TO END OF LIST - IF THERE ARE MORE	11000
CD		GROUPS, LAST GROUP DATA GIVEN IS USED	11010
CD	NBCS	NUMBER OF CONSTANTS FOR EXTERNAL BOUNDARIES	11020
CD		1- SINGLE VALUE USED EVERYWHERE	11030
CD		6- INDIVIDUAL VALUES FOR EACH POSSIBLE	11040
CD		SURFACE (BOUNDARY SPECS GIVE ACTUAL USE)	11050
CD		.GT.6- SIX VALUES ARE GIVEN FOR THE FIRST	11060
CD		ENERGY GROUP, THEN SIX FOR THE NEXT, TO	11070
CD		THE END OF LIST - THE LAST GROUP DATA	11080
CD		GIVEN APPLIES TO ALL ADDITIONAL GROUPS	11090
CD	NIBCS	NUMBER OF CONSTANTS FOR INTERNAL BOUNDARIES	11100
CD		1- SINGLE VALUE USED EVERYWHERE	11110
CD		.GT.1- VALUES ARE GIVEN BY ENERGY GROUP WITH	11120
CD		NON-BLACK CONDITION INDICATED BY ZERO	11130
CD		ENTRY - LAST VALUE APPLIES TO ADDITIONAL	11140
CD		GROUPS	11150
CD	NZWBB	NUMBER OF ZONES WHICH ARE BLACK ABSORBERS	11160
CD	NGOP	RESERVED	11170
C			11180
CW	27		11190
C			11200
C			11210
C			11220
C			11230
CR		INTERVAL BOUNDARIES	11240
C			11250
C			11260
CL		(XMESH(I),I=1,IM),(YMESH(J),J=1,JM),(ZMESH(K),K=1,KM)	11270
C			11280
CD	XMESH	DISTANCE TO INTERVAL BOUNDARY, FIRST DIMENSION	11290
CD	YMESH	DISTANCE TO INTERVAL BOUNDARY, SECOND DIMENSION	11300
CD	ZMESH	DISTANCE TO INTERVAL BOUNDARY, THIRD DIMENSION	11310
C			11320
CW	IM+JM+KM		11330
C			11340
C			11350

C	-----	11360
CR	GEOMETRY DATA	11370
C		11380
CL	(VOLR(N),N=1,NREG),(BSQ(N),N=1,NBS),	11390
CL	(BNDC(N),N=1,NBCS),(BNCI(N),N=1,NIBCS),(NZHBB(N),N=1,NZWBB),	11400
CL	(NZC(N),N=1,NZONE),(NZNR(N),N=1,NREG)	11410
C	-----	11420
CD	VOLR REGION VOLUMES, CC	11430
CD	BSQ BUCKLING (B**2) VALUES, CM-2	11440
CD	BNDC BOUNDARY CONSTANTS (DEL PHI / PHI = C*D)	11450
CD	BNCI INTERNAL BLACK BOUNDARY CONSTANTS	11460
CD	NZHBB ZONE NUMBERS WITH BLACK ABSORBER CONDITIONS	11470
CD	NZC ZONE CLASSIFICATIONS	11480
CD	NZNR ZONE NUMBER ASSIGNED TO EACH REGION	11490
C		11500
CW	2*NREG + NBS + NBCS + NIBCS + NZWBB + NZONE	11510
C		11520
C	-----	11530
C		11540
C	-----	11550
CR	REGION ASSIGNMENTS TO INTERVALS	11560
C		11570
CL	((MR(I,J),I=1,IM),J=1,JM)-----NOTE STRUCTURE BELOW-----	11580
C		11590
CS	DO 1 K=1,KM	11600
CS	1 READ(N) *LIST AS ABOVE*	11610
C		11620
CD	MR REGION NUMBER ASSIGNED TO INTERVAL	11630
C		11640
CW	IM*JM, KM TIMES	11650
C		11660
C	-----	11670
C		11680
C		11690
C		11700
C		11710

F. NDXSRF

This file is a compromise between the various techniques now used to relate nuclide densities with their geometric locations and associated microscopic cross sections. One of the problems is data storage. To facilitate the calculation of macroscopic cross sections, we are providing a neutron-energy-group-ordered file of microscopic cross sections. Thus, it is assumed that for the calculation of macro data,

$$\Sigma(r,g) = \sum_{N \in g} \sigma_N(g) N_N(r)$$

We can store the nuclide concentrations, N , in core, the macroscopic cross sections, Σ , by region for one group and the microscopic cross sections, σ , as needed. The N 's must be stored in core along with Σ for one group to avoid serious I/O problems. For fuel management processing, it is also very desirable to store the N 's. Now if we used the method of present S_N codes to store the N 's, it

would take three numbers to give a value of a nuclide density, the nuclide identification, and the geometric location. To store 10,000 nuclide concentrations would take 30,000 pieces of information. For representative problems, there is considerable symmetry which significantly reduces the 20,000 identifying numbers with the scheme chosen.

We also find one level of mixing to be very important. That is, for fuel management calculations, we need a subdivision on the "zone" basis. It is the intent of this file to provide this second level of subdivision in such a way that the neutronics code blocks may recognize and use it.

A problem will require microscopic cross-section data for each nuclide treated (NON of these). Several may be for the nuclide but the data is weighted in a broad-neutron-energy sense on different neutron spectra. Each nuclide treated separately (NON of them) is assigned a unique name (BNNAME) as well as absolute reference (BANAME). Having an absolute reference greatly simplifies the analyst's

problems of providing data for both exposure and fuel management calculations. In addition, certain very much needed data is contained in this file, such as energy per fission, atomic weights, and classification of the nuclides for both edit purposes and to simplify fuel management processing, much of it from the ISOTXS file.

A set of nuclides is defined simply as a list extracted from those contained in a library of microscopic cross sections, the GRUPXS file. These would normally be those nuclides which have a common location (at one or more sites) in a reactor. Identifying these allows appreciable reduction in the storage required for locating nuclides and relating their concentrations to microscopic cross sections.

Nuclide concentrations are assigned to zones directly, or to subzones which make up zones. Each zone is assigned a volume fraction which applies to those concentrations assigned to it directly (with no subzones, a unity volume fraction normally applies). Subzones associated with a zone make up the remaining fraction of the zone. The necessary volumes, subzone assignments to zones, and nuclide referencing data are provided. This referencing data is separated from the actual nuclide density data to allow one set of data in this file to be used with multiple sets of the densities. The density data, file ZNATDN, cannot be used without the information in NDXSRF.

C	*****	11720
C		11730
C	PREPARED MARCH 21, 1971 --- REASSESSED AUGUST, 1971	11740
C		11750
CF	NDXSRF	11760
C		11770
CE	NUCLIDE DENSITY, DATA, CROSS SECTION REFERENCING	11780
C		11790
C	*****	11800
C		11810
C	-----	11820
CR	IDENTIFICATION	11830
C		11840
CL	HNAME, (HUSE(I), I=1,2), IVERS	11850
C		11860
CD	HNAME HOLLERITH FILE NAME - NDXSRF - (A6)	11870
CD	HUSE HOLLERITH USER IDENTIFICATION (A6)	11880
CD	IVERS FILE VERSION NUMBER	11890
C		11900
C	-----	11910
C		11920
C	-----	11930
CR	SPECIFICATIONS	11940
C		11950
CL	NON, NSN, NNS, NAN, NZONE, NSZ, (NUD(I), I=1,10)	11960
C		11970
CD	NON NUMBER OF NUCLIDES IN CROSS SECTION DATA	11980
CD	NSN NUMBER OF NUCLIDE SETS IDENTIFIED	11990
CD	NNS MAXIMUM NUMBER OF NUCLIDES IN ANY SET	12000
CD	NAN NUMBER OF DIFFERENT NUCLIDES IN DATA	12010
CD	NZONE NUMBER OF ZONES	12020
CD	NSZ NUMBER OF SUBZONES (SUBASSEMBLIES)	12030
CD	NUD RESERVED	12040
C		12050
CW	16	12060
C	-----	12070
		12080
		12090

C	-----	12100
CR	NUCLIDE REFERENCING AND DATA	12110
C		12120
CL	(HNNAME(N),N=1,NON),(HANAME(N),N=1,NON),(WPF(N),N=1,NON),	12130
CL	(ATWT(J),J=1,NAN),(NCLN(N),N=1,NON),((NDXS(K,L),K=1,4),L=1,NSN),	12140
CL	((NOS(I,L),I=1,NNS),L=1,NSN),((NOR(N,L),N=1,NGN),L=1,NSN)	12150
CL		12160
C		12170
CD	HNNAME	UNIQUE REFERENCE NUCLIDE NAME, IN LIBRARY ORDER
CD		A(6) ALPHANUMERIC
CD	HANAME	ABSOLUTE NUCLIDE REFERENCE, IN LIBRARY ORDER
CD		A(6) ALPHANUMERIC
CD	WPF	ENERGY GENERATION, WATTS/FISSION
CD	ATWT	ATOMIC WEIGHT
CD	NCLN	NUCLIDE CLASSIFICATION
CD		1- FISSION
CD		2- FERTILE
CD		3- OTHER ACTINIDE
CD		4- FISSION PRODUCT
CD		5- STRUCTURAL
CD		6- COOLANT
CD		7- CONTROL ROD
CD		GREATER THAN 7, UNDEFINED
C		12330
CD	NDXS(K,L)	REFERENCE DATA FOR SET L
CD		K = 1, NUMBER OF NUCLIDES IN SET
CD		K = 2, RESERVED
CD		K = 3, RESERVED
CD		K = 4, RESERVED
CD	NOS(I,L)	ORDER NUMBER OF NUCLIDE IN CROSS SECTION DATA
CD		(IN HNNAME LIST) OF NUCLIDE ORDERED I IN
CD		SET L
CD	NOR(N,L)	ORDER NUMBER OF NUCLIDE IN SET L GIVEN ORDER
CD		NUMBER N IN CROSS SECTION DATA
C		12440
CW	NAN + 4*(NON + NSN) + NSN*(NNS + NON), PLUS 2*NON FOR 4-BYTE	12450
C		12460
C	-----	12470
C		12480
C	-----	12490
CR	NUCLIDE CONCENTRATION ASSIGNMENT DATA	12500
C		12510
CL	(VOLZ(N),N=1,NZONE),(VFPA(N),N=1,NZONE),(VLSA(M),M=1,NSZ),	12520
CL	(NSPA(N),N=1,NZONE),(NSSA(M),M=1,NSZ),(NZSZ(M),M=1,NSZ)	12530
C		12540
CD	VOLZ	VOLUMES OF ZONES, CC
CD	VFPA	VOLUME FRACTIONS FOR PRIMARY ZONE ASSIGNMENTS
CD	VLSA	VOLUMES OF SUBZONES
CD	NSPA	NUCLIDE SET REFERENCE, PRIMARY ZONE ASSIGNMENT
		(MAY BE ZERO ONLY IF THERE ARE SUBZONES)
CD	NSSA	NUCLIDE SET REFERENCE ASSIGNMENT TO SUBZONES
CD	NZSZ	ZONE CONTAINING SUBZONE
C		12620
C	NOTE THAT TO CALCULATE MACROSCOPIC CROSS SECTIONS FOR A ZONE,	12630
C	IT IS NECESSARY TO CONSIDER THE CONCENTRATION OF EACH NUCLIDE	12640
C	IN THE PRIMARY SET ASSIGNMENT (UNLESS A ZERO IN NSPA INDICATES	12650
C	THERE ARE NONE) TIMES THE VOLUME FRACTION, AND THE CONCENTRATION	12660
C	OF EACH NUCLIDE IN EACH SUBZONE ASSIGNED TO THE ZONE TIMES THE	12670
C	RATIO OF THE SUBZONE VOLUME TO THE ZONE VOLUME.	12680
C		12690
CW	3*(NZONE + NSZ)	12700
C		12710
C	-----	12720
C		12730
CEOF		12740
		12750

G. ZNATDN

This file contains the nuclide concentrations, atomic densities in atoms/b-cm. The technique of storage allocation that was selected is a compromise which

1. Allows easy processing of multiple files of data,
2. Permits processing the data for quite elaborate problems in a reasonable amount of data storage, and
3. Provides flexibility deemed necessary for the calculations which lie ahead.

The array of atomic densities contains the assignments directly to zones followed by the assignments to subzones, where a subzone is a part of a zone. Given the correspondence between subzones and zones, as well as the relationship between nuclide densities and microscopic data, macroscopic cross sections are calculated by the equation

$$\Sigma_x(r,g) = f_p(r) \sum_{n \in r} N_n(r) \sigma_{x,n}(g) + \sum_{s \in r} \frac{V(s)}{V(r)} \sum_{n \in s} N_n(s) \sigma_{x,n}(g) ,$$

where

$\Sigma_x(r,g)$ refers to cross-section type x at location r in energy group g ,

$f_p(r)$ is the volume fraction of the primary assignments,

$N_n(r)$ is the nuclide atomic density at location r of nuclide n ,

$\sigma_{x,n}(g)$ is the appropriate microscopic cross section,

$N_n(s)$ is the nuclide atomic density in subzone s in r ,

$V(s)$ is the volume associated with subzone s , and

$V(r)$ is the volume associated with zone r .

It is necessary to relate σ to N , using reference data of file NDXSERF. Given the nuclide order N in the density array ADEN for zone J , $L = \text{NSPA}(J)$ is the set reference, and $M = \text{NOS}(N,L)$ is the address or ordering in the sets of cross-section data, completing the relationship. Similarly, for a nuclide ordered N^1 in a subzone J^1 , $L^1 = \text{NSSA}(J^1)$ is the set reference, and $M^1 = \text{NOS}(N^1,L^1)$ is the address or ordering in the sets of cross-section data. The array WOR provides back referencing, the NDXS (1, set number) is number of nuclides in a set, and NZSZ relates subzones with zones. Note that nuclides in subzones of a zone may or may not use the same cross sections. This provides complete flexibility.

C	*****	12760
C		12770
C		12780
C	PREPARED MARCH 21, 1971 -- REASSESSED AUGUST, 1971	12790
C		12800
CF	ZNATDN	12810
C		12820
CE	ZONE ATOMIC DENSITIES (OF NUCLIDES)	12830
C		12840
C	*****	12850
		12860
C	-----	12870
CR	IDENTIFICATION	12880
C		12890
CL	HNAME,(HUSE(1),I=1,2),IVERS	12900
C		12910
CD	HNAME HOLLERITH FILE NAME - ZNATDN - (A6)	12920
CD	HUSE HOLLERITH USER IDENTIFICATION (A6)	12930
CD	IVERS FILE VERSION NUMBER	12940
		12950
C	-----	12960
		12970

CR	SPECIFICATIONS	12980
C		12990
CL	TIME, NCY, NTZSZ, NNS	13000
C		13010
CD	TIME	13020
CD	NCY	13030
CD	NTZSZ	13040
CD	NNS	13050
C		13060
CW	4	13070
C		13080
C		13090
C	-----	13100
C		13110
C		13120
CR	ZONE ATOMIC DENSITIES (OF NUCLIDES)	13130
C		13140
CL	((ADEN(N,J),N=1,NNS),J=1,NTZSZ)	13150
C		13160
CD	ADEN(N,J)	13170
CD		13180
CD		13190
C		13200
CW	NNS*NTZSZ	13210
C	-----	13220
		13230
CEOF		13240
		13250

H. SEARCH

This file is set up to provide flexible criticality search specifications, instructions as to how the system is to be altered to satisfy a specified multiplication factor. At the head of each block of data for a particular set of specifications, an integer identifier is located for direct referencing by a driver program. An unspecified number of blocks of this data may be placed in one SEARCH file, the whole terminated with a negative data set identifier WSHID.

The block of data for one search specification first contains such information as the desired multiplication factor (which could be subject to override by a driver) and the type of search.

For the usual reciprocal velocity (pseudo cross section) search, provision is made to use cross-section data from the library presented as if it were for a nuclide.

For dimension search, provision is made to make relative changes in "region thicknesses, where regions are presumed to be continuous (see the MR array in File GEODST) and perhaps on a finer scale than are zones.

Considerable flexibility is allowed in the specifications for nuclide concentration searches, although the restriction is imposed that adjustments may be made only on zone concentrations or on subzone concentrations. Nuclide referencing is through unique nuclide names.

C	*****	13260
C		13270
C		13280
C	PREPARED MARCH 21, 1971 -- REASSESSED AUGUST, 1971	13290
C		13300
CF	SEARCH	13310
C		13320
CE	CRITICALITY SEARCH DATA FILE	13330
C		13340
C	*****	13350
		13360

C	-----	13370
CR	IDENTIFICATION	13380
C		13390
CL	HNAME, (HUSE(I), I=1,2), IVERS	13400
C		13410
CS	DATA FOR EACH SEARCH SPECIFICATION FOLLOWS ITS IDENTIFIER	13420
CS	THESE SETS OF DATA ARE TERMINATED BY A NEGATIVE IDENTIFIER	13430
C		13440
C		13450
CD	HNAME HOLLERITH FILE NAME - SEARCH - (A6)	13460
CD	HUSE HOLLERITH USER IDENTIFICATION (A6)	13470
CD	IVERS FILE VERSION NUMBER	13480
C		13490
C	-----	13500
C		13510
C	-----	13520
CR	INDIVIDUAL DATA SET IDENTIFIER	13530
C		13540
CL	NSHID, (NSP(I), I=1,19)	13550
C		13560
CD	NSHID POSITIVE INTEGE- IDENTIFYING A SET OF SEA-CH	13570
CD	DATA	13580
CD	NSP RESERVED	13590
C		13600
CH	20	13610
C		13620
C	-----	13630
C		13640
C	-----	13650
CR	SPECIFICATIONS	13660
C		13670
CL	(SRCH(I), I=1,10), (NRCH(I), I=1,30)	13680
C		13690
CD	SRCH(1) DESIRED MULTIPLICATION FACTOR	13700
CD	SRCH(2) MULTIPLICATION FACTOR SLOPE	13710
CD	SRCH(3) CONVERGENCE CRITERION TO BE MET BY K	13720
CD	SRCH(4) CONVERGENCE CRITERION TO BE MET BY THE PRIMARY	13730
CD	VARIABLE ADJUSTED	13740
CD	SRCH(5) FACTOR APPLIED TO NUCLIDE CONCENTRATIONS VARIED	13750
CD	SPECIALLY (NSRCH(1) = 7 BELOW), MAY BE .LT.0	13760
CD	SRCH(6) -SRCH(10) RESERVED	13770
CD	NRCH(1) TYPE OF SEARCH	13780
CD	0- NOT DEFINED	13790
CD	1- BUCKLING SEARCH	13800
CD	2- ONE SET OF 1/V VALUES ALPHA SEARCH	13810
CD	3- SPACE VARIED 1/V VALUES ALPHA SEARCH	13820
CD	5- DIMENSION SEARCH	13830
CD	7- NUCLIDE CONCENTRATION SEARCH LIMITED TO	13840
CD	ADJUSTING CONCENTRATIONS PROPORTIONAL TO	13850
CD	THOSE IN THE SYSTEM PLUS INVERSE OPTION	13860
CD	9- NUCLIDE CONCENTRATION SEARCH BASED ON	13870
CD	ZONE-DEPENDENT NUCLIDE CONCENTRATIONS	13880
CD	NRCH(2) SUBZONE OPTION FOR NRCH(1) 7 OR 9	13890
CD	0- SEARCH DATA IS BY ZONE	13900
CD	1- SEARCH DATA IS BY SUBZONE	13910
CD	NRCH(4) MAXIMUM NUMBER OF NEUTRONICS PROBLEMS ALLOWED	13920
CD	IN THE COURSE OF A SEARCH PROBLEM - A ZERO	13930
CD	HERE SPECIFIES THE DIRECT SEARCH	13940
CD	NRCH(5) SEARCH-IDENTIFIER FOR NEUTRON BALANCE PURPOSES	13950
CD	0- UNSPECIFIED	13960
CD	1- CONTROL ROD	13970
CD	NRCH(6) NUMBER OF ZONES INVOLVED	13980
CD	NRCH(7) NUMBER OF SUBZONES INVOLVED	13990
CD	NRCH(8)-NRCH(18) USED ONLY AS DEFINED BELOW OR RESERVED	14000
CD	NRCH(19) UPDATE CROSS SECTION CYCLE FOR NRCH(1) = 0	14010
CD	NRCH(20) OPTIONS ON SEARCH RESULT REGARDING CONTINUATION	14020
CD	-1- ACCEPTABLE SOLUTION LIMITED TO FI.LT.0	14030
CD	WHERE EI IS THE EIGENVALUE OF THE SEARCH	14040
CD	PROBLEM	14050
CD	0- ANY SOLUTION ACCEPTABLE	14060
CD	1- EI LIMITED TO VALUES .GT.0 AND .LT.1	14070
CD	2- EI LIMITED TO .GT.1	14080

CD	NRCH(21)	TERMINATION OPTIONS ON ITERATIVE PROCESS	14090
CD		0- NO RESTRAINT	14100
CD		1- TERMINATE IF CONVERGENCE CRITERIA ARE NOT MET	14110
CD			14120
CD		2- TERMINATE ONLY IF THE PROBLEM DOES NOT APPEAR TO BE CONVERGING IF CONVERGENCE CRITERIA ARE NOT MET	14130
CD			14140
CD	NRCH(22)	TERMINATION OPTIONS ON NUCLIDE CONCENTRATIONS	14150
CD		0- TERMINATE IF ANY NUCLIDE CONCENTRATION BECOMES NEGATIVE AT ANY STAGE OF THE CALCULATION	14160
CD			14170
CD		1- TERMINATE IF ANY NUCLIDE CONCENTRATION IS NEGATIVE AT THE END OF THE SEARCH	14180
CD			14190
CD		2- ALLOW NEGATIVE NUCLIDE CONCENTRATIONS	14200
CD			14210
C			14220
CW	40		14230
C			14240
C			14250
C			14260
C			14270
C			14280
CR		1/V DATA ASSIGNMENTS, PRESENT ONLY IF NRCH(1) = 3	14290
C			14300
CL	(HVNNAME(I),I=1,NRCH(6))		14310
C			14320
CD	HVNNAME	ASSIGNMENT OF A PSEUDO NUCLIDE NAME FOR EACH ZONE WHICH ABSORPTION CROSS SECTION IS TO BE USED AS 1/V DATA	14330
CD			14340
CD			14350
C			14360
CW	NRCH(6)		14370
C			14380
C			14390
C			14400
C			14410
CR		REGION THICKNESS PARAMETERS FOR ADJUSTING DIMENSIONS, PRESENT ONLY IF NRCH(1) = 5	14420
CR			14430
C			14440
CL	(SRHD1(I),J=1,NRCH(8), (SRHD2(I),I=1,NRCH(9)), SRHD3(I),I=1, NRCH(10))		14450
CL			14460
C			14470
CD	SRHD1	FIRST DIMENSION RELATIVE THICKNESS CHANGE FOR SEARCH BY REGION	14480
CD			14490
CD	SRHD2	SECOND DIMENSION RELATIVE THICKNESS CHANGE FOR SEARCH BY REGION	14500
CD			14510
CD	SRHD3	THIRD DIMENSION RELATIVE THICKNESS CHANGE FOR SEARCH BY REGION	14520
CD			14530
C			14540
C		NOTE THAT ONLY ONE OF NRCH(8), NRCH(9), AND NRCH(10) MIGHT BE NON-ZERO.	14550
C			14560
C			14570
CW	NRCH(8) + NRCH(9) + NRCH(10)		14580
C			14590
C			14600
C			14610
C			14620
CR		IDENTIFICATION OF SEARCH NUCLIDES, PRESENT ONLY IF NRCH(1) = 7	14630
CR			14640
C			14650
CL	(NSHZ1(I),NSHZ2(I),(HNNAMS(N,I),N=1,NRCH(8)),I=1,NRCH(9)), (HNSHN(J),J=1,10)		14660
CL			14670
C			14680
CD	NSHZ1	FIRST NUMBER OF A SET OF ZONES, OR OF A SET OF SUBZONES IF NRCH(2)=1	14690
CD			14700
CD	NSHZ2	LAST NUMBER OF A SET OF ZONES	14710
CD	HNNAMS	NUCLIDE REFERENCE NAME WHOS CONCENTRATION IS TO BE ADJUSTED PROPORTIONATELY IN THE ABOVE ZONES, A(6) ALPHANUMERIC	14720
CD			14730
CD			14740
CD	NRCH(8)	LENGTH OF NUCLIDE LIST LENGTH	14750
CD	NRCH(9)	NUMBER OF SETS OF THESE SPECIFICATIONS	14760
CD	HNSHN	SEARCH NUCLIDE REFERENCE A(6) ALPHANUMERIC, USED AS NOTED BELOW	14770
CD			14780
C			14790

CW	10+(NRCH(8)+2)*NRCH(9), 20 + 2*(NRCH(8)+1)*NRCH(9) 4-BYTE	14800
C		14810
C	NOTE THAT CONCENTRATIONS ARE ADJUSTED FOR THESE NUCLIDES	14820
C	SPECIFIED BY THE EQUATION	14830
C	$C2 = C1 * E1$	14840
C	WHERE E1 IS THE EIGENVALUE, EXCEPT FOR SPECIAL NUCLIDES	14850
C	IDENTIFIED AS HNSHN, AND	14860
C	$C2 = C1 + C1*(1.0-E1)*SRCH(5),$	14870
C	C1 BEING THE CONCENTRATION AT THE START OF THE PROBLEM,	14880
C	C2 THAT ON RESOLUTION OF THE PROBLEM OR INTERMEDIATE	14890
C	ESTIMATES, HNSHN APPLIES ONLY IF IN THE SET	14900
C		14910
C	-----	14920
C		14930
C	-----	14940
CR	IDENTIFICATION OF SEARCH NUCLIDES AND RELATIVE CONCENTRATION	14950
CR	CHANGES BY ZONE, PRESENT IF NRCH(1) = 9	14960
C		14970
CL	(NSHZ1(I),NSHZ2(I),(HNNAMS(N,I),N=1,NRCH(8)),(CHZDN(N,I),N=1,	14980
CL	NRCH(8)),I=1,NRCH(9))	14990
C		15000
CD	NSHZ1 FIRST NUMBER OF A SET OF ZONES,	15010
CD	OR OF A SET OF SUBZONES IF NRCH(2)=1	15020
CD	NSHZ2 LAST NUMBER OF A SET OF ZONES	15030
CD	HNNAMS NUCLIDE REFERENCE NAME WHOS CONCENTRATION IS TO	15040
CD	BE ADJUSTED AS DEFINED BELOW, A(6)	15050
CD	CHZDN CONCENTRATION CHANGE OF CORRESPONDING NUCLIDE	15060
CD	NRCH(8) LENGTH OF NUCLIDE LIST LENGTH	15070
CD	NRCH(9) NUMBER OF SETS OF THESE SPECIFICATIONS	15080
C		15090
C	NOTE THAT THE CONCENTRATIONS ARE ADJUSTED FOR THE NUCLIDES	15100
C	SPECIFIED BY THE EQUATION (BY ZONE IF NRCH(2) IS 0,	15110
C	OR BY SUBZONE IF NRCH(2) = 1)	15120
C	$C2=C1 + E1*CHZDN$	15130
C	WHERE E1 IS THE EIGENVALUE AND CHZDN IS THE SPECIFIED	15140
C	CHANGE WHICH MAY BE NEGATIVE	15150
C	C1 BEING THE CONCENTRATION AT THE START OF THE PROBLEM,	15160
C	C2 THAT ON RESOLUTION OF THE PROBLEM OR INTERMEDIATE	15170
C	ESTIMATES	15180
C		15190
CW	(2*NRCH(8) + 2)*NRCH(9), 2*(2*NRCH(8) + 1)*NRCH(9) 4-BYTE	15200
C		15210
C	-----	15220
		15230
		15240
CENF		15250
		15260

I. SNCONS

It will be noted that two dummy items are included in the Specifications Record to fill out the list to four words. In order for the search for the four words in the Identification Record to be executable, every record in the files must contain at least four words.

The number of directions NDIR in this file will depend upon the S_n order and the geometry type. It may be observed that the algorithm used in determining NDIR is somewhat arbitrary. For example, a

different algorithm is used in the TWOTRAN code than was used in earlier two-dimensional S_n codes which leads to different values for NDIR. For this and other reasons, the determination of NDIR is here taken to be a function of the input processor. The retrieval of directions and weights from a library or from input is also assumed to be an input processor function.

```

C*****
C
C                                     PREPARED 3/5/71
C
C
CF      SNCONS
CE      SN CONSTANTS
C
C*****

```

```

C-----
CR      IDENTIFICATION
C
CL      HNAME,(HUSE(I),I=1,2),IVERS
C
CW      4
C
CD      HNAME          MOLLERITH FILE NAME - SNCONS - (A6)
CD      HUSE           MOLLERITH USER IDENTIFICATION (A6)
CD      IVERS          FILE VERSION NUMBER
C
C-----

```

```

C-----
CR      SPECIFICATIONS
C
CL      NDIM,NDIR,IDUM,IDUM
C
CW      4
C
CD      NDIM           NUMBER OF DIMENSIONS
CD      NDIR           NUMBER OF DIRECTIONS
CD      IDUM           UNDEFINED. USED TO OBTAIN FOUR WORD RECORD.
C
C-----

```

```

C-----
CR      ONE DIMENSIONAL SN CONSTANTS
C
CC      PRESENT IF NDIM.EQ.1
C
CL      (DIRWGT(I),I=1,NDIR),(DIRMU(I),I=1,NDIR)
C
CW      2*NDIR
C
CD      DIRWGT         DIRECTION WEIGHT FOR EACH DIRECTION
CD      DIRMU          DIRECTION COSINE FOR EACH DIRECTION
C
C-----

```

```

C-----
CR      MULTI-DIMENSIONAL SN CONSTANTS
C
CC      PRESENT IF NDIM.GE.2
C
CL      (DIRWGT(I),I=1,NDIR),(DIRMU(I),I=1,NDIR),(DIRETA(I),I=1,NDIR)
C
CW      3*NDIR
C
CD      DIRWGT         DIRECTION WEIGHT FOR EACH DIRECTION
CD      DIRMU          DIRECTION COSINES WITH RESPECT TO FIRST
CD                      DIMENSION.
CD      DIRETA         DIRECTION COSINES WITH RESPECT TO SECOND
CD                      DIMENSION.
C
C-----

```

CEOF

J. FIXSRC

This file provides for distributed and surface sources in one, two, or three dimensions. It may be used with either diffusion or S_n codes. Distributed sources are sources situated at mesh point centers. A directed distributed source can be used with S_n codes. One application would be to gamma transport problems. Legendre coefficients are computed in the S_n codes whenever anisotropic scattering is treated. The same coefficients can be applied to anisotropic distributed sources. Consequently, the number of components of a distributed source, NDCOMP, depends upon the order of anisotropy specified for scattering, which, in turn, is limited

by the S_n order specified. NDCOMP would, therefore, be determined during input processing. NDCOMP = 1, for diffusion codes.

It is expected that surface sources will be used primarily for coupling separate flux calculations. These sources reside on mesh point boundaries and, as such, are necessarily directed sources. The number of components of surface source NSCOMP is two in diffusion theory corresponding to a flux and current at the boundary. NSCOMP equals NDIR, the number of S_n directions, in S_n calculations.

Mesh boundary pointers are used in the file to provide the capability for specifying sources at any of the surfaces defined by the mesh.

```

C*****S*****
C
C                                     PREPARED 3/5/71
C
CF      FIXSRC
CE      DISTRIBUTED AND SURFACE FIXED SOURCES
C
C*****

```

```

C-----
CR      IDENTIFICATION
C
CL      HNAME, (HUSE(I), I=1,2), IVERS
C
CW      4
C
CD      HNAME      HOLLERITH FILE NAME - FIXSRC - (A6)
CD      HUSE       HOLLERITH USER IDENTIFICATION (A6)
CD      IVERS      FILE VERSION NUMBER
C
C-----

```

```

C-----
CR      SPECIFICATIONS
C
CL      ITYPE,NDIM,NGROUP,NINT1,NINTJ,NINTK,IDISTS,NDCOMP,NSCOMP,NEDGJ,
CL      NFDGJ,NEDGK
C
CW      1?
C
CD      ITYPE      TYPE SOURCE. 0=DIFFUSION
CD                      1=SN
CD      NDIM       NUMBER OF DIMENSIONS
CD      NGROUP     NUMBER OF GROUPS
CD      NINT1      NUMBER OF FIRST DIMENSION INTERVALS
CD      NINTJ      NUMBER OF SECOND DIMENSION INTERVALS
CD      NINTK      NUMBER OF THIRD DIMENSION INTERVALS
CD      IDISTS     DISTRIBUTED SOURCE FLAG.
CD                      0= NO DISTRIBUTED SOURCE GIVEN.
CD                      1= DISTRIBUTED SOURCE IS GIVEN.
CD      NDCOMP     NUMBER OF DISTRIBUTED SOURCE COMPONENTS
CD      NSCOMP     NUMBER OF SURFACE SOURCE COMPONENTS
CD      NFDGJ      NUMBER OF FIRST DIMENSION BOUNDARY SOURCES
CD      NFDGJ      NUMBER OF SECOND DIMENSION BOUNDARY SOURCES
CD      NFDGK      NUMBER OF THIRD DIMENSION BOUNDARY SOURCES
C
C-----

```

```

C-----
CR      ONE-DIMENSIONAL DISTRIBUTED FIXED SOURCE
C
CC      PRESENT IF NDIM.EQ.1 AND IDISTS.NE.0
C
CL      ((QDIST(I,J),I=1,NINTI),J=1,NGROUP)---NOTE STRUCTURE BELOW---
C
CW      NINTI*NGROUP
C
C      DO 1 L=1,NDCOMP
C      1 READ (N) *LIST AS ABOVE*
C
CD      QDIST          DISTRIBUTED SOURCE BY INTERVAL, GROUP, AND
CD                      COMPONENT.
C
C-----

```

```

C-----
CR      MULTI-DIMENSIONAL DISTRIBUTED FIXED SOURCE
C
CC      PRESENT IF NDIM.GE.2 AND IDISTS.NE.0
C
CL      ((QDIST(I,J),I=1,NINTI),J=1,NINTJ)---NOTE STRUCTURE BELOW---
C
CW      NINTI*NINTJ
C
C      DO 1 L=1,NDCOMP
C      DO 1 N=1,NGROUP
C      DO 1 K=1,NINTK
C      1 READ (N) *LIST AS ABOVE*
C
CD      QDIST          AS DEFINED ABOVE.
C
C-----

```

```

C-----
CR      FIRST DIMENSION SURFACE SOURCE POINTERS
C
CC      PRESENT IF NEDGI.NE.0
C
CL      ((ISPTRI(I,J),I=1,NBDRYI),J=1,NINTJ)---NOTE STRUCTURE BELOW---
C
CW      NBDRYI*NINTJ
C
C      DO 1 K=1,NINTK
C      1 READ (N) *LIST AS ABOVE*
C
CD      ISPTRI          ISPTRI(I,J) DENOTES THE INTERCEPT OF CHANNEL
CD                      J,K WITH MESH BOUNDARY PLANE I. IF ISPTRI(I,J)
CD                      =0, NO SURFACE SOURCE IS PRESENT AT THE
CD                      INTERCEPT. IF ISPTRI(I,J)=M, THE MTH SURFACE
CD                      SOURCE SPECIFIED IN THE NEXT RECORD BELOW IS
CD                      PRESENT AT THE INTERCEPT.
CD      NBDRYI          =NINTI+1, NUMBER OF FIRST DIMENSION BOUNDARIES
C
C-----

```

```

C-----
CR      FIRST DIMENSION SURFACE SOURCES
C
CC      PRESENT IF NEDGI.NE.0
C
CL      ((QSURFI(M,N,L),M=1,NEDGI),N=1,NGROUP),L=1,NSCOMP)
C
CW      NEDGI*NGROUP*NSCOMP
C
CD      QSURFI          FIRST DIMENSION BOUNDARY SOURCES BY BOUNDARY,
CD                      GROUP, AND COMPONENT.
C
C-----

```

```

C-----
CR      SECOND DIMENSION SURFACE SOURCE POINTERS
C
C      PRESENT IF NDIM.GE.2 AND NEDGJ.NE.0
C
CL      ((ISPTRJ(I,J),I=1,NINTI),J=1,NBDRYJ)---NOTE STRUCTURE BELOW---
C
CW      NINTI*NBDRYJ
C
C      DO 1 K=1,NINTK
C      1 READ (N) *LIST AS ABOVE*
C
CD      ISPTRJ      ISPTRJ(I=J) DENOTES THE INTERCEPT OF CHANNEL
CD                  I,K WITH MESH BOUNDARY PLANE J. IF ISPTRJ(I,J)
CD                  =0, NO SURFACE SOURCE IS PRESENT AT THE
CD                  INTERCEPT. IF ISPTRJ(I,J)=M, THE MTH SURFACE
CD                  SOURCE SPECIFIED IN THE NEXT RECORD BELOW IS
CD                  PRESENT AT THE INTERCEPT.
CD      NBDRYJ      =NINTJ+1, NUMBER OF SECOND DIMENSION BOUNDARIES-
C
C-----
C
CR      SECOND DIMENSION SURFACE SOURCES
C
C      PRESENT IF NDIM.GE.2 AND NEDGJ.NE.0
C
CL      ((QSURFJ(M*N,L),M=1,NEDGJ),N=1,NGROUP),L=1,NSCOMP)
C
CW      NEDGJ*NGROUP*NSCOMP
C
CD      QSURFJ      SECOND DIMENSION BOUNDARY SOURCES BY BOUNDARY
CD                  GROUP, AND COMPONENT
C
C-----
C
CR      THIRD DIMENSION SURFACE SOURCE POINTERS
C
C      PRESENT IF NDIM.EQ.3 AND NEDGK.NE.0
C
CL      ((ISPTRK(I,J),I=1,NINTI),J=1,NINTK)---NOTE STRUCTURE BELOW---
C
CW      NINTI*NINTJ
C
C      DO 1 K=1,NBDRYK
C      1 READ (N) *LIST AS ABOVE*
C
CD      ISPTRK      ISPTRK(I,J) DENOTES THE INTERCEPT OF CHANNEL
CD                  I,J WITH MESH BOUNDARY PLANE K. IF ISPTRK(I,J)
CD                  =0, NO SURFACE SOURCE IS PRESENT AT THE
CD                  INTERCEPT. IF ISPTRK(I,J)=M, THE MTH SURFACE
CD                  SOURCE SPECIFIED IN THE NEXT RECORD BELOW IS
CD                  PRESENT AT THE INTERCEPT.
CD      NBDRYK      =NINTK+1, NUMBER OF THIRD DIMENSION BOUNDARIES
C
C-----
C
CR      THIRD DIMENSION SURFACE SOURCES
C
C      PRESENT IF NDIM.EQ.3 AND NEDGK.NE.0
C
CL      ((QSURFK(M*N,L),M=1,NEDGK),N=1,NGROUP),L=1,NSCOMP)
C
CW      NEDGK*NGROUP*NSCOMP
C
CD      QSURFK      THIRD DIMENSION BOUNDARY SOURCES BY BOUNDARY,
CD                  GROUP, AND COMPONENT.
C
C-----

```

CEOF

K. RTFLUX and ATFLUX

Except for adapting the specifications to block transfer and separating the regular from the adjoint flux, the new specifications for the total flux are the same as in the old GRPFLX file. The specification of the group order according to decreasing

energy for the regular case and according to increasing energy for the adjoint case conforms to normal flux code output. This avoids a useless sort of the adjoint data and, further, avoids a resort when ATFLUX is used for restart.

```
C*****
C
C          PREPARED 3/5/71
C
C          RTFLUX
C          REGULAR TOTAL FLUXES
C
C*****
```

```
CD          ORDER OF GROUPS IS ACCORDING TO DECREASING
CD          ENERGY.
```

```
C-----
CR          IDENTIFICATION
C
CL          HNAME,(HUSE(I),I=1,2),IVERS
C
CW          4
C
CD          HNAME          HOLLERITH FILE NAME - RTFLUX - (A6)
CD          HUSE           HOLLERITH USER IDENTIFICATION (A6)
CD          IVERS          FILE VERSION NUMBER
C
C-----
```

```
C-----
CR          SPECIFICATIONS
C
CL          NDIM,NGROUP,NINTI,NINTJ,NINTK,ITER,EFFK,POWER
C
CW          8
C
CD          NDIM           NUMBER OF DIMENSIONS
CD          NGROUP         NUMBER OF ENERGY GROUPS
CD          NINTI          NUMBER OF FIRST DIMENSION INTERVALS
CD          NINTJ          NUMBER OF SECOND DIMENSION INTERVALS
CD          NINTK          NUMBER OF THIRD DIMENSION INTERVALS
CD          ITER           OUTER ITERATION NUMBER AT WHICH FLUX WAS
CD                        WRITTEN
CD          EFFK           EFFECTIVE MULTIPLICATION FACTOR
CD          POWER          POWER IN WATTS TO WHICH FLUX IS NORMALIZED
C
C-----
```

```
C-----
CR          ONE DIMENSIONAL REGULAR TOTAL FLUX
C
CC          PRESENT IF NDIM.EQ.1
C
CL          ((FREG(I,J),I=1,NINTI),J=1,NGROUP)
C
CW          NINTI*NGROUP
C
CD          FREG           ONE DIMENSIONAL REGULAR TOTAL FLUX BY INTERVAL
CD                        AND GROUP.
C
C-----
```

```

C-----
CR      MULTI-DIMENSIONAL REGULAR TOTAL FLUX
C
CC      PRESENT IF NDIM.GE.2
C
CL      ((FREG(I,J),I=1,NINTI),J=1,NINTJ)-----NOTE STRUCTURE BELOW-----
C
CW      NINTI*NINTJ
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      1 READ(N) *LIST AS ABOVE*
C
CD      FREG      MULTI-DIMENSIONAL REGULAR TOTAL FLUX
CD      BY INTERVAL AND GROUP.
C
C-----

```

CEOF

```

C.....
C
C      PREPARED 3/5/71
C
CF      ATFLUX
CE      ADJOINT TOTAL FLUXES
C
C.....

```

```

CD      ORDER OF GROUPS IS ACCORDING TO INCREASING
CD      ENERGY.

```

```

C-----
CR      IDENTIFICATION
C
CL      HNAME,(HUSE(I),I=1,2),IVERS
C
CW      4
C
CD      HNAME      HOLLERITH FILE NAME - ATFLUX - (A6)
CD      HUSE       HOLLERITH USER IDENTIFICATION (A6)
CD      IVERS      FILE VERSION NUMBER
C
C-----

```

```

C-----
CR      SPECIFICATIONS
C
CL      NDIM,NGROUP,NINTI,NINTJ,NINTK,ITER,EFFK
C
CW      7
C
CD      NDIM      NUMBER OF DIMENSIONS
CD      NGROUP    NUMBER OF ENERGY GROUPS
CD      NINTI     NUMBER OF FIRST DIMENSION INTERVALS
CD      NINTJ     NUMBER OF SECOND DIMENSION INTERVALS
CD      NINTK     NUMBER OF THIRD DIMENSION INTERVALS
CD      ITER      OUTER ITERATION NUMBER AT WHICH FLUX WAS
CD               WRITTEN
CD      EFFK      EFFECTIVE MULTIPLICATION FACTOR
C
C-----

```

```

C-----
CR      ONE DIMENSIONAL ADJOINT TOTAL FLUX
C
CC      PRESENT IF NDIM.EQ.1
C
CL      ((FADJ(I,J),I=1,NINTI),J=1,NGROUP)
C
CW      NINTI*NGROUP
C
CD      FADJ      ONE DIMENSIONAL ADJOINT TOTAL FLUX BY INTERVAL
CD      AND GROUP.
C
C-----

C-----
CR      MULTI-DIMENSIONAL ADJOINT TOTAL FLUX
C
CC      PRESENT IF NDIM.GE.2
C
CL      ((FADJ(I,J),I=1,NINTI),J=1,NINTJ)-----NOTE STRUCTURE BELOW-----
C
CW      NINTI*NINTJ
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      1 RFAD(N)  *LIST AS ABOVE*
C
CD      FADJ      MULTI-DIMENSIONAL ADJOINT TOTAL FLUX
CD      BY INTERVAL AND GROUP.
C
C-----
CEOF

```

1. RCURNT and ACURNT

In conformance with the recommendations of the Committee, currents have been specified at mesh point boundaries rather than at mesh centers. In addition, the mesh-centered values can always be derived simply from the boundary values, but the converse is not true. Boundary currents are

somewhat awkward to specify (and treat analytically) in multidimensional cases because the current in each direction must be handled as a separate vector function of the mesh. The order chosen in RCURNT and ACURNT corresponds to an i, j, k sweep over the mesh where i is varying most rapidly.

The group ordering is the same as that in the total flux files.

```

C*****
C
C      PREPARED 3/5/71
C
CF      RCURNT
CE      REGULAR CURRENTS
C
C*****

CD      ORDER OF GROUPS IS ACCORDING TO DECREASING
CD      ENERGY.

```

```

C-----
CR          IDENTIFICATION
C
CL      HNAME,(HUSE(I),I=1,2),IVERS
C
CW      4
C
CD      HNAME          HOLLERITH FILE NAME - RCURNT - (A6)
CD      HUSE           HOLLERITH USER IDENTIFICATION (A6)
CD      IVERS          FILE VERSION NUMBER
C
C-----

```

```

C-----
CR          SPECIFICATIONS
C
CL      NDIM,NGROUP,NINTI,NINTJ,NINTK
C
CW      5
C
CD      NDIM          NUMBER OF DIMENSIONS
CD      NGROUP        NUMBER OF GROUPS
CD      NINTI         NUMBER OF FIRST DIMENSION MESH INTERVALS
CD      NINTJ         NUMBER OF SECOND DIMENSION MESH INTERVALS
CD      NINTK         NUMBER OF THIRD DIMENSION MESH INTERVALS
C
C-----

```

```

C-----
CR          ONE DIMENSIONAL REGULAR CURRENT
C
CC          PRESENT IF NDIM.EQ.1
C
CL      ((RCURI(I,J),I=1,NBDRYI),J=1,NGROUP)
C
CW      NBDRYI*NGROUP
C
CD      RCURI          ONE DIMENSIONAL REGULAR CURRENT BY MESH POINT
CD                      BOUNDARY AND GROUP
CD      NBDRYI         *NINTI+1, NUMBER OF FIRST DIMENSION MESH POINT
CD                      BOUNDARIES
C
C-----

```

```

C-----
CR          MULTI-DIMENSIONAL REGULAR CURRENTS AT FIRST DIMENSION
CR          BOUNDARIES
C
CC          PRESENT IF NDIM.GE.2
C
CL      ((RCURI(I,J),I=1,NBDRYI),J=1,NINTJ)----NOTE STRUCTURE BELOW----
C
CW      NBDRYI*NINTJ
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      1 RFAD(N) *LIST AS ABOVE*
C
CD      RCURI          REGULAR FIRST DIMENSION BOUNDARY CURRENT
C
C-----

```

```

C-----
CR      MULTI-DIMENSIONAL REGULAR CURRENTS AT SECOND DIMENSION
CR      BOUNDARIES
C
C      PRESENT IF NDIM.GE.2
C
CL      ((RCURJ(I,J),I=1,NINTI),J=1,NBDRYJ)----NOTE STRUCTURE BELOW----
C
CW      NINTI*NBDRYJ
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      1 READ(N) *LIST AS ABOVE*
C
CD      RCURJ      REGULAR SECOND DIMENSION BOUNDARY CURRENT
CD      NBDRYJ     =NINTJ+1, NUMBER OF SECOND DIMENSION BOUNDARIES-
C-----

```

```

C-----
CR      MULTI-DIMENSIONAL REGULAR CURRENTS AT THIRD DIMENSION
CR      BOUNDARIES.
C
C      PRESENT IF NDIM.EQ.3
C
CL      ((RCURK(I,J),I=1,NINTI),J=1,NINTJ)----NOTE STRUCTURE BELOW----
C
CW      NINTI*NINTJ
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NBDRYK
C      1 READ(N) *LIST AS ABOVE*
C
CD      RCURK      REGULAR THIRD DIMENSION BOUNDARY CURRENT
CD      NBDRYK     =NINTK+1, NUMBER OF THIRD DIMENSION BOUNDARIES
C-----

```

CEOF

```

C*****
C
C      PREPARED 3/5/71
C
CF      ACURNT
CE      ADJOINT CURRENTS
C
C*****

CD      ORDER OF GROUPS IS ACCORDING TO INCREASING
CD      ENERGY.

C-----
CR      IDENTIFICATION
C
CL      HNAME,(HUSE(I),I=1,2),IVERS
C
CW      4
C
CD      HNAME      MOLLERITH FILE NAME - ACURNT - (A6)
CD      HUSE       MOLLERITH USER IDENTIFICATION (A6)
CD      IVERS      FILE VERSION NUMBER
C-----

```



```

C-----
CR          SPECIFICATIONS
C
CL      NDIM,NGROUP,NINTI,NINTJ,NINTK
C
CW      5
C
CD      NDIM          NUMBER OF DIMENSIONS
CD      NGROUP        NUMBER OF GROUPS
CD      NINTI         NUMBER OF FIRST DIMENSION MESH INTERVALS
CD      NINTJ         NUMBER OF SECOND DIMENSION MESH INTERVALS
CD      NINTK         NUMBER OF THIRD DIMENSION MESH INTERVALS
C
C-----

```

```

C-----
CR          ONE DIMENSIONAL ADJOINT CURRENT
C
CC          PRESENT IF NDIM.EQ.1
C
CL      ((ACURI(I,J),I=1,NBDRYI),J=1,NGROUP)
C
CW      NBDRYI*NGROUP
C
CD      ACURI          ONE DIMENSIONAL ADJOINT CURRENT BY MESH POINT
CD                      BOUNDARY AND GROUP
CD      NBDRYI        =NINTI+1, NUMBER OF FIRST DIMENSION MESH POINT
CD                      BOUNDARIES
C
C-----

```

```

C-----
CR          MULTI-DIMENSIONAL ADJOINT CURRENTS AT FIRST DIMENSION
CR          BOUNDARIES
C
CC          PRESENT IF NDIM.GE.2
C
CL      ((ACURI(I,J),I=1,NBDRYI),J=1,NINTJ)----NOTE STRUCTURE BELOW----
C
CW      NBDRYI*NINTJ
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      1 READ(N) *LIST AS ABOVE*
C
CD      ACURI          ADJOINT FIRST DIMENSION BOUNDARY CURRENT
C
C-----

```

```

C-----
CR          MULTI-DIMENSIONAL ADJOINT CURRENTS AT SECOND DIMENSION
CR          BOUNDARIES
C
CC          PRESENT IF NDIM.GE.2
C
CL      ((ACURJ(I,J),I=1,NINTI),J=1,NBDRYJ)----NOTE STRUCTURE BELOW----
C
CW      NINTI*NBDRYJ
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      1 READ(N) *LIST AS ABOVE*
C
CD      ACURJ          ADJOINT SECOND DIMENSION BOUNDARY CURRENT
CD      NBDRYJ        =NINTJ+1, NUMBER OF SECOND DIMENSION BOUNDARIES
C
C-----

```

```

C-----
CR          MULTI-DIMENSIONAL ADJOINT CURRENTS AT THIRD DIMENSION
CR          BOUNDARIES.
C
CC          PRESENT IF NOIM.EQ.3
C
CL          ((ACURK(I,J),I=1,NINTI),J=1,NINTJ)----NOTE STRUCTURE BELOW----
C
CW          NINTI*NINTJ
C
C          DO 1 L=1,NGROUP
C          DO 1 K=1,NBDRYK
C          1 RFAO(N) *LIST AS ABOVE*
C
CD          ACURK          ADJOINT THIRD DIMENSION BOUNDARY CURRENT
CD          NBDRYK         =NINTK+1, NUMBER OF THIRD DIMENSION BOUNDARIES
C
C-----

```

CEOF

M. RAFLUX and AAFLUX

Mesh boundary values for the angular fluxes are specified, and the structure of the angular flux files is consistent with the structure of the current files. The angular fluxes APREG(M) at each mesh point boundary may be combined to obtain the boundary current using

$$J = \sum_{M=1}^{NDR} \text{DIRWGT}(M) * \text{DIRCO}(M) * \text{APREG}(M)$$

where the DIRWGT are the weights and the DIRCO are the direction cosines with respect to the given

dimension. Once this transformation is made, the ordering of the angular flux data is seen to be equivalent to the ordering of the current data.

Because of transformations performed in S_n codes to solve adjoint problems, the group order of adjoint fluxes is inverse to the regular order, and the directions associated with the fluxes are reflected with respect to the regular directions. Since for most applications the adjoint ordering is as convenient as the regular ordering, sorting of the adjoint data to make it conform to the regular ordering is not proposed.

```

C*****
C
C          PREPARED 3/5/71
C
CF          RAFLUX
CE          REGULAR ANGULAR FLUX
C
C*****

CD          ORDER OF GROUPS IS ACCORDING TO DECREASING
CD          ENERGY.

C-----
CR          IDENTIFICATION
C
CL          HNAME,(HUSE(I),I=1,2),IVERS
C
CW          4
C
CD          HNAME          HOLLERITH FILE NAME - RAFLUX - (A6)
CD          HUSE           HOLLERITH USER IDENTIFICATION (A6)
CD          IVERS          FILE VERSION NUMBER
C
C-----

```

```

C-----
CR          SPECIFICATIONS
C
CL      NDIM,NGROUP,NINTI,NINTJ,NINTK,NDIR,EFFK,POWER
C
CM      8
C
CD      NDIM          NUMBER OF DIMENSIONS
CD      NGROUP        NUMBER OF GROUPS
CD      NINTI         NUMBER OF FIRST DIMENSION INTERVALS
CD      NINTJ         NUMBER OF SECOND DIMENSION INTERVALS
CD      NINTK         NUMBER OF THIRD DIMENSION INTERVALS
CD      NDIR          NUMBER OF DIRECTIONS
CD      EFFK          EFFECTIVE MULTIPLICATION FACTOR
CD      POWER         POWER IN WATTS TO WHICH FLUX IS NORMALIZED
C
C-----

```

```

C-----
CR          REGULAR ANGULAR FLUXES AT FIRST DIMENSION BOUNDARIES
C
CL      ((AFREGI(M,I),M=1,NDIR),I=1,NBDRYI)----NOTE STRUCTURE BELOW---
C
CM      NDIR=NBDRYI
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      DO 1 J=1,NINTJ
C      1 READ (N) *LIST AS ABOVE*
C
CD      AFREGI          REGULAR FIRST DIMENSION BOUNDARY ANGULAR FLUX
CD      NBDRYI          =NINTI+1, NUMBER OF FIRST DIMENSION MESH POINT
CD                      BOUNDARIES.
C
C-----

```

```

C-----
CR          REGULAR ANGULAR FLUXES AT SECOND DIMENSION BOUNDARIES
C
CC          PRESENT IF NDIM.GE.2
C
CL      ((AFREGJ(M,I),M=1,NDIR),I=1,NINTI)----NOTE STRUCTURE BELOW---
C
CM      NDIR=NINTI
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      DO 1 J=1,NBDRYJ
C      1 READ (N) *LIST AS ABOVE*
C
CD      AFREGJ          REGULAR SECOND DIMENSION BOUNDARY ANGULAR FLUX
CD      NBDRYJ          =NINTJ+1, NUMBER OF SECOND DIMENSION MESH POINT-
CD                      BOUNDARIES.
C
C-----

```

```

C-----
CR      REGULAR ANGULAR FLUXES AT THIRD DIMENSION BOUNDARIES
C
CC      PRESENT IF NDIM.EQ.3
C
CL      ((AFPGK(M,I),M=1,NDIR),I=1,NINTI)----NOTE STRUCTURE BELOW----
C
CW      NDIR=NINTI
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NDRYK
C      DO 1 J=1,NINTJ
C      1 READ (N) *LIST AS ABOVE*
C
CD      AFREGK      REGULAR THIRD DIMENSION BOUNDARY ANGULAR FLUX
CD      NDRYK      =NINTK+1. NUMBER OF THIRD DIMENSION MESH POINT
CD                  BOUNDARIES.
C
C-----

```

CEOF

```

C*****
C
C      PREPARED 3/5/71
C
CF      AAFLUX
CE      ADJOINT ANGULAR FLUX
C
C*****

```

```

CD      ORDER OF GROUPS IS ACCORDING TO INCREASING
CD      ENERGY. THE DIRECTION NUMBERS M=1,NDIR DENOTE
CD      DIRECTIONS WHICH ARE REFLECTED WITH RESPECT TO
CD      THE DIRECTIONS GIVEN IN THE SNCONS FILE.

```

```

C-----
CR      IDENTIFICATION
C
CL      HNAME,(HUSE(I),I=1,2),IVERS
C
CW      4
C
CD      HNAME      HOLLERITH FILE NAME - AAFLUX - (A6)
CD      HUSE      HOLLERITH USER IDENTIFICATION (A6)
CD      IVERS      FILE VERSION NUMBER
C
C-----

```

```

C-----
CR      SPECIFICATIONS
C
CL      NDIM,NGROUP,NINTI,NINTJ,NINTK,NDIR,EFFK
C
CW      7
C
CD      NDIM      NUMBER OF DIMENSIONS
CD      NGROUP     NUMBER OF GROUPS
CD      NINTI      NUMBER OF FIRST DIMENSION INTERVALS
CD      NINTJ      NUMBER OF SECOND DIMENSION INTERVALS
CD      NINTK      NUMBER OF THIRD DIMENSION INTERVALS
CD      NDIR      NUMBER OF DIRECTIONS
CD      EFFK      EFFECTIVE MULTIPLICATION FACTOR
C
C-----

```

```

C-----
CR      ADJOINT ANGULAR FLUXES AT FIRST DIMENSION BOUNDARIES
C
C      ((AFADJI(M,I),M=1,NDIR),I=1,NBDRYI)----NOTE STRUCTURE BELOW----
C
CW      NDIR=NBDRYI
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      DO 1 J=1,NINTJ
C      1 READ (N) *LIST AS ABOVE*
C
CD      AFADJI      ADJOINT FIRST DIMENSION BOUNDARY ANGULAR FLUX
CD      NBDRYI      =NINTI+1, NUMBER OF FIRST DIMENSION MESH POINT
CD                      BOUNDARIES.
C
C-----

```

```

C-----
CR      ADJOINT ANGULAR FLUXES AT SECOND DIMENSION BOUNDARIES
C
CC      PRESENT IF NDIM.GE.2
C
C      ((AFADJJ(M,I),M=1,NDIR),I=1,NINTI)----NOTE STRUCTURE BELOW----
C
CW      NDIR=NINTI
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NINTK
C      DO 1 J=1,NBDRYJ
C      1 READ (N) *LIST AS ABOVE*
C
CD      AFADJJ      ADJOINT SECOND DIMENSION BOUNDARY ANGULAR FLUX
CD      NBDRYJ      =NINTJ+1, NUMBER OF SECOND DIMENSION MESH POINT-
CD                      BOUNDARIES.
C
C-----

```

```

C-----
CR      ADJOINT ANGULAR FLUXES AT THIRD DIMENSION BOUNDARIES
C
CC      PRESENT IF NDIM.EQ.3
C
C      ((AFADJK(M,I),M=1,NDIR),I=1,NINTI)----NOTE STRUCTURE BELOW----
C
CW      NDIR=NINTI
C
C      DO 1 L=1,NGROUP
C      DO 1 K=1,NBDRYK
C      DO 1 J=1,NINTJ
C      1 READ (N) *LIST AS ABOVE*
C
CD      AFADJK      ADJOINT THIRD DIMENSION BOUNDARY ANGULAR FLUX
CD      NBDRYK      =NINTK+1, NUMBER OF THIRD DIMENSION MESH POINT
CD                      BOUNDARIES.
C
C-----

```

CEOF

N. RZFLUX

This file contains a volumetric average of the regular neutron flux by broad energy group for each geometric zone. Also included is reference integral data, primarily about the overall neutron balance.

```

C * * * * * 8980
C 8990
C 9000
C      PREPARED MARCH 21, 1971 -- REASSESSED AUGUST, 1971 9010
C 9020
CF      RZFLUX 9030
C 9040
CE      REGULAR ZONE FLUX BY GROUP, AVERAGED OVER EACH ZONE 9050
C 9060
C * * * * * 9070
C 9080
C - - - - - 9090
CR      IDENTIFICATION 9100
C 9110
CL      HNAME,(HUSE(I),I=1,2),IVERS 9120
C 9130
CD      HNAME          HOLLERITH FILE NAME - RZFLUX - (A6) 9140
CD      HUSE           HOLLERITH USER IDENTIFICATION (A6) 9150
CD      IVERS          FILE VERSION NUMBER 9160
C 9170
C - - - - - 9180
C 9190
C - - - - - 9200
CR      INTEGRAL DATA 9210
C 9220
CL      TIME, POWER, VOL, KEFF, EIVS, DKDS, TNL, TNA, TNSL, TNBL, TNBAL, 9230
CL      TNCRA, (X(I),I=1,4), ITRVS, NZONE, NGROUP NCY 9240
C 9250
CD      TIME          REFERENCE REAL TIME, DAYS 9260
CD      POWER         POWER LEVEL FOR ACTUAL NEUTRONICS PROBLEM, WATTS 9270
CD                      THERMAL 9280
CD      VOL           VOLUME OVER WHICH POWER WAS DETERMINED, CC 9290
CD      KEFF          MULTIPLICATION FACTOR 9300
CD      EIVS          EIGENVALUE OF SEARCH PROBLEM 9310
CD      DKDS          DERRIVATIVE OF SEARCH PROBLEM 9320
CD      TNL           TOTAL NEUTRON LOSSES 9330
CD      TNA           TOTAL NEUTRON ABSORPTIONS 9340
CD      TNSL          TOTAL NEUTRON SURFACE LEAKAGE 9350
CD      TNBL          TOTAL NEUTRON BUCKLING LOSS 9360
CD      TNBAL         TOTAL NEUTRON BLACK ABSORBER LOSS 9370
CD      TNCRA         TOTAL NEUTRON CONTROL ROD ABSORPTIONS 9380
CD      X(I),I=1,4    RESERVED 9390
CD      ITPS          ITERATIVE PROCESS STATE, 9400
CD                      0 = NO ITERATIONS DONE 9410
CD                      1 = CONVERGENCE SATISFIED 9420
CD                      2 = NOT CONVERGED, BUT CONVERGING 9430
CD                      3 = NOT CONVERGED, NOT CONVERGING 9440
CD      NZONE         NUMBER OF GEOMETRIC ZONES 9450
CD      NGROUP        NUMBER OF NEUTRON ENERGY GROUPS 9460
CD      NCY           REFERENCE COUNT (CYCLE NUMBER) 9470
C 9480
CM      20 9490
C 9500
C - - - - - 9510
C 9520
C - - - - - 9530
CR      FLUX VALUES 9540
CL      ((ZGF(K,M),K=1,NGROUP),M=1,NZONE) 9550
C 9560
CD      ZGF           REGULAR ZONE FLUX BY GROUP, AVERAGED OVER ZONE, 9570
CD                      NEUTRONS/SEC-CM**2 9580
C 9590
CM      NGROUP*NZONE 9600
C 9610
C - - - - - 9620
C 9630
C 9640
C 9650

```

CEDE

O. PWDINT

This file contains a space map of the local thermal power density by interval. In the event there are other files generated which are mappings in space (no energy dependence), the format used for this file is recommended.

```

C * * * * * 9660
C 9670
C 9680
C     PREPARED MARCH 21, 1971 -- REASSESSED AUGUST, 1971 9690
C 9700
CF     PWDINT 9710
C 9720
CE     POWER DENSITY BY INTERVAL 9730
C 9740
C * * * * * 9750
C 9760
C - - - - - 9770
CR     IDENTIFICATION 9780
C 9790
CL     HNAME,(HUSE(I),I=1,2),IVERS 9800
C 9810
CD     HNAME          HOLLERITH FILE NAME - PWDINT - (A6) 9820
CD     HUSE            HOLLERITH USER IDENTIFICATION (A6) 9830
CD     IVERS           FILE VERSION NUMBER 9840
C 9850
C - - - - - 9860
C 9870
C - - - - - 9880
CR     SPECIFICATIONS 9890
C 9900
CL     TIME, POWER, VOL, IM, JM, KM, NCY 9910
C 9920
CD     TIME            REFERENCE REAL TIME, DAYS 9930
CD     POWER            POWER LEVEL FOR ACTUAL NEUTRONICS PROBLEM, WATTS 9940
CD                        THERMAL 9950
CD     VOL              VOLUME OVER WHICH POWER WAS DETERMINED, CC 9960
CD     IM               NUMBER OF FIRST DIMENSION INTERVALS 9970
CD     JM               NUMBER OF SECOND DIMENSION INTERVALS 9980
CD     KM               NUMBER OF THIRD DIMENSION INTERVALS 9990
CD     NCY              REFERENCE COUNT (CYCLE NUMBER) 10000
C 10010
CW     7 10020
C 10030
C - - - - - 10040
C 10050
C - - - - - 10060
CR     POWER DENSITY VALUES 10070
C 10080
CL     ((PWR(I,J),I=1,IM),J=1,JM)-----NOTE STRUCTURE BELOW----- 10090
C 10100
CS     DO 1 K=1,KM 10110
CS     1 READ(N) *LIST AS ABOVE* 10120
C 10130
CD     PWR              POWER DENSITY BY INTERVAL, WATTS/CC 10140
C 10150
CW     IM*JM, KM TIMES 10160
C 10170
C - - - - - 10180
C 10190
CEOF 10200
      10210

```

REFERENCE

1. "Report and Recommendation of the Committee on Computer Code Coordination," D. K. Butler, Chairman, Prepared for the Advisory Committee on Reactor Physics. Los Alamos, New Mexico, November 4-5, 1970.